THE UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR MICHIKO KAWASHIMA

TITLE OF THESIS THE ACQUISITION OF JAPANESE RELATIVE CLAUSES

DEGREE FOR WHICH THESIS WAS PRESENTED MASTER OF SCIENCE

YEAR THIS DEGREE GRANTED FALL, 1980

THE UNIVERSITY OF ALBERTA

THE ACQUISITION OF JAPANESE RELATIVE CLAUSES

by

© MICHIKO KAWASHIMA

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

IN

PSYCHOLINGUISTICS

DEPARTMENT OF LINGUISTICS

EDMONTON, ALBERTA

FALL, 1980

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled THE ACQUISITION OF JAPANESE RELATIVE CLAUSES submitted by MICHIKO KAWASHIMA in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE in PSYCHOLINGUISTICS.

This thesis is

dedicated to my parents,

Hidesaku and Tomie Mori

ABSTRACT

The present study investigates the effects of developmental principles on processing of Japanese relative clauses.

Based on Slobin (1973), a set of developmental principles was formulated in Prideaux (1979): these are the principles of cognitive precedence, functional exploitation, grammatical uniqueness and structural integrity. The operation of these principles in language acquisition is tested on Japanese speaking children's processing of conjoined sentences and relative clauses in comprehension and imitation. Two hypotheses are formulated as to differential processing of four types of relative clauses based on the principle of structural integrity: one concerns predictable ease of processing of left-branching relative clauses (SS,SO types) over center-embedded structures (OS,OO types), and the other concerns ease of processing of subject focused relative clauses (SS,OS types) over object focused ones (SO,OO types). Sixteen children ranged from five to eight in age served as the subjects.

The results indicate that the developmental principles are operative in Japanese children's processing of conjoined sentences and relative clauses. Among the relative clause structures, left-branching relative clauses were processed

significantly better than center-embedded structures, thus supporting the hypothesis of non-interruption. The other hypothesis which states that subject focus is easier to process than object focus, however, is not supported by the data.

The present study indicates that the position of the relative clause is the most important factor to affect the child's processing of relative clause structures. The results that children had considerable processing difficulty with center-embedded structures provide evidence for the universal constraint against interruptions.

ACKNOWLEDGEMENTS

I would first like to express my sincere appreciation to my supervisor, Dr. G. D. Prideaux, for his continuous guidance and encouragement throughout my Master's program. His patience and suggestion have greatly helped improving the organization and quality of this thesis.

I am also indebted to the other members of my committee: Dr. J. T. Hogan for his assistance with the statistical analysis, Dr. M. L. Marckworth for her helpful suggestions on various aspects of my research, and Dr. K. T. Holden for his critical comments on the organization of the thesis.

Many thanks are also extended to a number of people who have assisted me during the preparation of this thesis. The children of the Metro Edmonton Japanese Community School patiently cooperated through the data collection period. Many of my fellow students in the Department of Linguistics have continuously provided me with their moral support. In particular, Mayadevi has helped me a great deal through her expertise in TEXTFORM in the production of the thesis.

Finally, I wish to express my special thanks to my husband, Junichi, and children, Jun and Ken, for their patience and understanding throughout my Master's program.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

1.1 Preliminaries

The role of language in cognitive development has been discussed by psychologists such as Piaget(1967, 1970). Recently in arguing for the primacy of cognitive development over linguistic development, Slobin writes that:

> The pacesetter in linguistic growth is the child's cognitive growth, as opposed to an autonomous linguistic development which can then reflect back on cognition. (1973, p. 184)

In fact, many cross-linguistic studies seem to support Slobin's claim, indicating that children start to express the same ideas at the same time and that the ideas expressed follow the same order of development across languages. Another line of evidence comes from the common observation that children cannot be taught linguistic constructions which convey meanings beyond their current cognitive ability.

According to cognitive precedence, cognitively complex structures should appear later in language development than cognitively simpler ones. The acquisition of a given form, however, is also affected by the structure of the form itself. Therefore, two kinds of complexity should be noted when we talk about linguistic complexity: cognitive complexity and formal complexity. As Slobin has put it, the former may fall within the domain of cognitive psychology

and the latter has to be pursued by psycholinguistics.

1.2 The Aim of the Study

Slobin (1973) suggested that it may be possible to identify children's processing strategies on the basis of cross-linguistic language acquisition data. According to this approach, it is assumed that once they are established, the strategies can be used to predict the degree of complexity of a given form, and accordingly its place of emergence in language acquisition, relative to other forms, can be predicted. Based on Slobin's proposals, Prideaux (1979) formulated a set of developmental principles related to language acquisition. These are the principles of cognitive precedence, functional exploitation, grammatical uniqueness, and structural integrity. The principles were evaluated in terms of English relative clause acquisition data, and were found to be operative and capable of predicting the order of acquisition of various types of structures containing relative clauses (Prideaux, 1979).

The present study was designed to explore the operation of these principles in the acquisition of Japanese relative clauses. Japanese was chosen as a second testing ground for the developmental principles since, as an S O V language, it has relative clause structures which differ radically from its English analogues. For a sentence containing a subject (S), transitive verb (V) and object (O), a relative clause can be formed on either the subject or object NP in both

Japanese and English. Furthermore, if the relative clause has a subject, transitive verb and object, either the subject or object NP can be relativized. Thus, for a given sentence of the form S O V, there are four possible structures containing relative clauses, assuming one relative clause per sentence. These are to be labelled throughout this thesis as SS, SO, OS, and OO. The first letter of each pair represents the NP on which the relative clause is formed (subject or object), while the second letter represents the relativized NP within the relative clause.

Japanese differs from English in its relative clause formation in two distinct ways. In English a relative clause follows the noun being modified, while in Japanese the relative clause precedes the modified NP. In English, the relativized noun within the relative clause is realized by a relative pronoun, whereas in Japanese, the relativized NP is deleted. Thus, Japanese has a "syntactic gap" in a relative clause in the position of the relativized NP, whereas in English, a relative pronoun is formed and is moved to the front of the relative clause.

These two important structural differences distinguishing Japanese and English syntax provide a useful arena for testing the viability of the developmental principles discussed above. One persistent danger in language acquisition studies is that the strategies or principles which are proposed to explain certain data

actually turn out to be language-specific. Consequently, Slobin's (1973) insistence on data from a wide range of languages with widely differing structures is one means of ensuring that the viable principles and strategies are in fact general or universal and not simply artifacts of a particular syntactic form or of an experimental technique.

Harada, Uyeno, Hayashibe & Yamada (1976) and K. Harada(1976) both reported experimental studies of the acquisition of Japanese relative clauses. The former investigated comprehension and the latter imitation. While the comprehension study was carried out on a large scale, the imitation study involved only one two-year-old girl. Since an experiment with more subjects of wider age range was needed, the present study was designed to investigate the child's processing of relative clause structures, replicating the study of Harada et al. and extending it further in providing data from imitation.

1.3 Overview

Chapter Two consists of a review of studies of relative clause constructions. First, relative clause structures of both English and Japanese are described, followed by a review of experimental studies of relative clauses with adults as subjects. Developmental principles are discussed and evaluated in terms of data from English and Japanese acquisition studies. The two hypotheses are formulated based

on one of the principles. In Chapter Three the plan of the experiment is described. The results of the experiment and discussion follow in Chapter Four. The results confirm one of the hypotheses. Chapter Five summarizes the main findings of the present experiment and proposes further studies to be carried out to elaborate sentence processing strategies of not only children but adults as well.

2. A REVIEW OF STUDIES OF RELATIVE CLAUSE CONSTRUCTIONS

2.1 Introduction

The effect of the location of a relative clause on sentence comprehension has long attracted the attention of linguists and psycholinguists alike. It has been generally assumed that center-embedded structures are more difficult to process than right- or left-branching relative clause structures (e. g., Chomsky & Miller, 1963; Chomsky, 1965; Kuno, 1973). While various experimental studies have been carried out with adult subjects to test this assumption, the question remains whether such experimental findings shed light on the child's acquisition of those structures. Provided that the adult and the child tend to respond fairly similarly as to complexity of the structures, additional questions are: Are the child's processing strategies of relative clauses the same as those of adults? Are the strategies language dependent or independent?

This chapter is devoted to a review of studies of relative clause structures. The chapter consists of five sections. First, relative clause structures of both English and Japanese are briefly described. Secondly, experimental studies of relative clauses with adult subjects are reviewed, followed by a discussion of processing strategies. The third section addresses the child's sentence processing

strategies. Developmental principles are discussed and evaluated on the basis of empirical data from English developmental studies. A discussion of Japanese developmental studies in terms of the developmental principles follows in the fourth section. Finally, in the fifth section the motivation and objectives of the present study are stated.

2.2 Description of Relative Clause Structures

A relative clause is one which modifies a noun phrase of another clause. In his attempts to define universal features of relative clauses, Downing (1978) suggests the following three semantic universals of relative clauses: (1) a nominal of a relative clause is coreferential with a nominal outside of the clause (the former nominal is referred to as the relative noun, while the latter is the antecedent or the head); (2) a relative clause must be statement about the relative noun and the head; (3) a relative clause, especially a restrictive relative clause, makes an assertion about the head, restricting the head to those nouns of which that the assertion is true. Although Downing claims that there are no universal syntactic properties of relative clause structures because of their great diversity across languages, there can be discerned a positional typology. That is, the position of a restrictive relative clause can be predicted according to the word order of a given language: VO languages generally make use of post

nominal relative clauses, whereas in SOV languages they are usually prenominal. Consequently, when English and Japanese are compared, the relative clause of Japanese (an SOV language) is oppositely placed to that of English (an SVO language). Now, when the basic word order of either language is considered, a relative clause can be formed on the subject or object NP. Furthermore, if the function of the relative noun in the relative clause is taken into consideration, the following four types of relative clause structures are observed in both languages (disregarding the case in which relative clauses are formed on both the subject and object NP):

(1) *English*

Subject/Subject (SS):

S1 [RP V2 O2] V1 O1

The girl who/that hit the boy broke the doll.

Subject/Object (SO):

S1 [RP S2 V2] V1 O1

The girl who/that/Ø the boy hit broke the doll.

Object/Subject (OS):

S1 V1 O1 [RP V2 O2]

The girl hit the boy who/that broke the doll.

Object/Object (OO):

S1 V1 O1 [RP S2 V2]

The girl hit the doll which/that/Ø the boy broke.

(2) *Japanese*

SS:

[(S)	O2	V2]	S1	O1	V1
(zoo ga)	kirin o	taosita	zoo ga	sika o	nadeta

(The elephant that knocked down the giraffe patted the deer.)

SO:

[S2	(O)	V2]	S1	O1	V1
zoo ga	(kirin o)	taosita	kirin ga	sika o	nadeta

(The giraffe that the elephant knocked down patted the deer.)

OS:

S1	[(S)	O2	V2]	O1	V1
zoo ga	(sika ga)	kirin o	taosita	sika o	nadeta

(The elephant patted the deer that knocked down the giraffe.)

OO:

S1	[S2	(O)	V2]	O1	V1
zoo ga	kirin ga	(sika o)	taosita	sika o	nadeta

(The elephant patted the deer that the giraffe knocked down.)

The English sentences and structures are taken, with minor modification, from Prideaux (1979), while the Japanese examples are from Uyeno, Harada, Hayashibe & Yamada (1977). The codings SS, SO, OS and OO indicate the grammatical relations respectively of the head and the relative noun. For example, in SS the first S indicates that the head is the subject of the main clause and the second S indicate that the relative NP is the subject of the relative clause. The numbers refer to the constituents of the main and

relative clauses, respectively.

Two important structural differences between the two languages need to be mentioned, one concerning relative pronouns and the other the position of relative clauses. An English relative clause must have an overt relative pronoun except when the pronoun is the object or when both the pronoun and a verb *be* are omitted. However, a Japanese relative clause has no relative pronoun: the relativized noun is obligatorily deleted from the relative clause. The English relative clause follows the modified noun, whereas the Japanese relative clause precedes. Thus, both English and Japanese have center-embedded relative clauses, although in English a center-embedded clause modifies the subject of the main clause, whereas it modifies the object in Japanese.[1]These structural differences between English and Japanese provide a convenient testing ground for examining processing strategies in terms of quite different syntactic properties.

---

[1]In the literature the term "self-embedding" is used interchangeably with "center-embedding". Self-embedded constructions are a special case of nested-constructions which are defined as the constructions inserted into the middle of another construction. The inserted constructions are called "self-embedded" providing that both inserting and inserted constructions are of the same type (Chomsky, 1965). The term "center-embedding" is used to refer to this type of the constructions hereafter.

2.3 Experimental Studies of Relative Clauses with Adults as Subjects

One of the main interests that recent psycholinguistic studies have been concerned with is the investigation of sentence complexity in terms of formal syntactic properties. The failure of early efforts to define the processing complexity of a sentence as a function of the number of grammatically assumed transformational rules in its derivation has led researchers to turn to an alternative approach, namely, the possibility that sentence processing complexity is a function of the degree to which surface syntactic features offer clues in recovering underlying representations (Fodor & Garrett, 1967). The shift of research interests is reflected in a number of studies of relative clauses carried out in the late sixties which purported to investigate how the presence or absence of a relative pronoun affects subjects' understanding of relative clause structures (e.g., Fodor & Garrett, 1967; Foss & Lynch, 1969; Hakes & Cairns, 1970). Those studies suggest an orientation in which researchers try to relate the comprehension of complex sentences to certain surface syntactic features.

In addition, one of the most extensively discussed syntactic aspects of relative clause constructions as related to the comprehension problem deals with the location of a relative clause in the sentence. It has been generally assumed that center-embedded relative clause structures are

more complex, and therefore more difficult to comprehend, than right-branching or left-branching ones (e.g., Chomsky & Miller, 1963; Chomsky, 1965; Kuno, 1973). There have been several studies reported in this regard, each of which will be reviewed here.

Early in the sixties, Miller and Isard (1964) tested subjects' ability to memorize sentences constructed of varying degrees of center-embedding. Twenty-four subjects were presented a right-branching as well as four center-embedded structures: the former had four relative clauses, each of which was placed at the right end of another construction; the latter were varied in terms of the number of embedded clauses (one, two, three, or four center-embeddings). Subjects were asked to memorize the sentences, repeating them after each of five presentations. It was shown that most subjects could learn structures with a single center-embedding equally well as right-branching. Some subjects managed to learn sentences with two center-embeddings, but not more than two. Miller and Isard concluded that structures of a single center-embedding are as easy for most people as those of right-branching. Gaer (1969) also investigated sentence complexity, using right-branching and center-embedded structures. While the center-embedded sentences contained a single embedding, right-branching sentences contained either single or double relative clauses. Comprehension and production for both

adults and children of age 3 to 6 were tested. In order to assess comprehension, a picture identification task was employed in which subjects were instructed to give an affirmative answer if the picture showed what they heard and a negative answer if it did not. Production was measured by means of imitation, and immediately after each presentation of the sentence five random numbers were read. The comprehension results for the adults showed no significant difference between center-embedded and right-branching structures. On the other hand, production yielded different results: the percentage of the sentences correctly produced was almost the same between center-embedded and right-branching sentences with a single relative clause, but turned out to be significantly less in right-branching sentences with double relative clauses. In short, these studies seem to suggest that there is no significant difference of difficulty in comprehension between right-branching and single center-embedded constructions.

Quite recently Sheldon (1976, 1977) challenged those experimental results and the assumptions that right- or left-branching are easier than center-embedded structures. She carried out a series of experiments to assess adults' comprehension of relative clause structures. The attention of the previous researches was centered only on the assumed effects of the locations of relative clauses on comprehension. Sheldon further tried to factor out the difference of the word order in the relative clause which

results from the differences in the function of the relative pronouns. She constructed four types of relative clauses, depending on the function of the head and the function of the relative pronoun in the relative clause, as illustrated in (1) in the previous section. In this way, a detailed analysis of the formal properties of relative clause structures can be specified, both in terms of the location of relative clauses and in terms of the function of the relative pronoun, and consequently the word order within the relative clause.

Forty-nine English speaking adults were presented eighty tape-recorded sentences containing relative clauses, one example being "The cook that saw the boy liked the poet" (1977). Following the presentation of each sentence, subjects were asked two questions, one of which concerned the proposition of the main clause, e.g. "Who liked whom?" and another of which concerned the proposition of the relative clause, e.g. "Who saw whom?" Sheldon's results turned out to be radically different from those of Gaer (1969). While Gaer found that the 95.5 percent and 96 percent of adults correctly understood right-branching and center-embedded relative clauses, respectively, Sheldon found only 48 percent correct responses for center-embedded and 56 percent for right-branching relative clauses.[2] The difference may be attributed to the different tasks required

---

[2]Gaer does not specify which type of relative clauses were used. However, an example of test sentences includes OS and SO types(1969, p. 290).

in each study: a picture identification task in Gaer's and a memory probe in Sheldon's.

The number of correct sentences in Sheldon's experiment are as follows: SS had 509 correct responses, SO 439, OS 607, and OO 490 (out of the total 980 sentences for each type). The easiest type is OS, and the hardest SO, in the order of OS>SS>OO>SO. There was a significant difference observed between center-embedded SS,SO types and right-branching OS,OO types; the former is harder than the latter. Secondly, the errors made in the relative clause structures of which the relative pronoun is the object, that is, object focused SO,OO types, were greater than those in SS,OS (subject focus) types. Since the rate of mistakes due to object focus was higher than those due to center-embedding, Sheldon argued that subjects' processing ability of relative clauses is more affected by the focus than the location of relative clauses.

The study demonstrated two main findings: first, center-embedding is relatively difficult, and secondly, the relative clauses in which the relativized NP is the object, however, are more difficult to process than center-embedded structures. Errors made in object focused relative clauses were greater than those in center-embedded structures. Regarding the difficulty of comprehension of center-embedded structures, Sheldon argued that two variables are confounded. The difficulty may be due to the location of the relative clause or the fact that the relative clause

modifies the subject of the main clause. In order to clarify this point as well as to investigate the assumed complexity of center-embedded over left-branching constructions, Sheldon devised another experiment in which judgements of sentence complexity were compared between English and Japanese speakers (1976). As explained above, a center-embedded relative clause modifies the subject of the main clause in English, whereas in Japanese it modifies the object. Therefore, if center-embedding proves to be difficult for Japanese speakers, then the results should support the claim of difficulty caused by the factor of the location of relative clause in the sentence, independent of the factor of the head which the relative clause modifies.

Subjects consisted of 32 Japanese speakers and 40 English speakers. Twenty relative clauses of four types were presented, and the subjects were asked to judge the sentences in terms of complexity by ranking those on the scale from 1 (the easiest) to 4 (the hardest). Both English and Japanese results are shown in Table 2.1:

Table 2.1

Mean Ranks Assigned to Each Sentence Type

	SO	OO	SS	OS
Japanese	3.3	2.5	2.5	1.7
English	3.1	3.2	2.2	1.5

In both languages, relative clauses in which the relative

noun is the object, namely, object focus, were judged significantly harder than those in which the relative noun is the subject, subject focus. As to the position of the relative clauses, Japanese speakers did not think center-embedded structures were harder than left-branching, whereas in English center-embedded structures were judged more complex than right-branching. The effect of the object focus, however, overrides the effect of the position of the relative clause in English. The findings that the object focus was judged more complex than center-embedded structures led Sheldon to conclude that the English results support those of the memory probe study and that the same tendency observed in both English and Japanese studies suggests a greater complexity of the object focused relative clauses regardless of language.

A few comments about Sheldon's Japanese data are in order. The results of Japanese speakers' judgement are quite different from those of a developmental study carried out by Harada et al. (1976), which will be reviewed below. The differences may be due to different ages of subjects (adults versus children), or they may be due to different particles employed in the main clause. In Sheldon's study a thematic particle *wa* is used, while a nominative particle *ga* is used in Harada et al. The subject marker in the relative clause is always *ga* in Japanese. What effects the usage of different particles has on sentence complexity is an open question. Furthermore, whether the same correlation is found

between judgement and memory probe studies in Japanese speakers as is found in English also needs to be investigated before any hasty conclusions are drawn.

In this section various studies concerned with complexity of relative clause structures have been reviewed. In particular, Sheldon's experiments using explicitly formulated sentence types as stimuli revealed an order of perceived complexity of four types of relative clause structures. The next question is whether the order of complexity of sentences observed in adults' studies is reflected in developmental studies. In other words, does the child learn first OS,SS types, which were found easier, and SO,OO types later? Furthermore, the question of why one type is easy and the other is difficult is naturally raised. While developmental aspects of relative clauses will be discussed in the following sections, I will now turn to the latter question.

When a sentence is said to be complex, it is presumably both relatively difficult to understand and to produce. One aspect of sentence complexity may be associated with production, whereas another may be involved with comprehension. It is generally assumed that if one cannot understand a structure, one cannot use it appropriately (see Gaer, 1969). Accordingly, the comprehension of complex sentences has usually been the primary concern in most

studies, including those reviewed above. What is comprehension, then? First of all, we have to clarify the process of comprehension, that is; "By what mental process do people listen to, comprehend and remember what they hear?" (Clark & Clark, 1977, p. 4). Clark and Clark's characterization of the comprehension process suggests three stages, namely, perceiving sounds, mapping the sounds onto meaning and storing the meaning in the memory. A narrow definition of comprehension is related to the last two stages, in which the hearer identifies a surface structure from a stream of sounds, puts an interpretation on it, and retains it. In fact, there is a suggestion that the interpretation placed on a surface structure may be expressed in the form of a proposition and kept in memory. Clark and Clark point out that when people try to remember a sentence, they often cannot reproduce it verbatim, but instead frequently confuse it with paraphrases which represent the same propositions. Therefore, it is reasoned that if the proposition which is retrieved from memory is analyzed in the light of features of surface structure, one can speculate as to how people process sentences. Based on the analysis of correct and incorrect interpretations which subjects make, various processing strategies have been proposed. Clark and Clark suggest that people use both semantic and syntactic strategies. Semantic strategies make use of contextual meaning or lexical meaning in a sentence. An example in which semantic strategies are used is

demonstrated in Stolz's experiment (1967). Stolz presented semantically supported sentences such as (3)a, and semantically neutral sentences such as (3)b, asking subjects to decompose them into simple sentences.

(3) a. The vase that the maid that the agency hired dropped broke on the floor.

b. The baker that the butcher that the candlestick-maker paid congratulated borrowed 200 dollars.

Stolz found semantically supported sentences are better understood than semantically neutral sentences. As matter of fact, he noted that the language user relies heavily on word meaning to bypass syntactic processing. However, sentences can be understood in the absence of semantic association between words. Bever (1970) argued that people use sequential and syntactic information based on the order of words in a sentence when there is no specific semantic information available. He proposed the following processing strategy, labeled "sequential labeling strategy" (p. 298):

> Any noun-verb-noun (NVN) sequence within a potential initial unit in the surface structure corresponds to "actor-action-object".

Other syntactic strategies suggested make use of function words, affixes, and grammatical categories of content words as cues. One example given in the previously mentioned studies suggests that the presence of relative pronouns facilitates comprehension of center-embedded structures (Fodor & Garret, 1967; Hakes & Cairns, 1970). Certain syntactic forms are easily understood, and since it is

plausible that syntactic strategies are used in processing sentences, those forms provide clues as to what the strategies are. Hence, psycholinguists not only describe the relation between complexity and formal properties, but try to investigate the relation between formal properties and processing strategies.

Sheldon (1977), following this trend, speculated as to what processing strategy subjects are using in decoding relative clause structures. Relative clause structures have two propositions: one in the main clause and the other in the relative clause. Therefore, based on the assumption that meaning is stored in the form of propositions, researchers may ask subjects to express the meaning of a sentence in two propositions as Sheldon did. The way the propositions are expressed could indicate how the sentence is processed.

Analysis of incorrect responses in the English memory probe study led Sheldon to propose that subjects adopted the following processing strategy in parsing relative clauses:

> *Adjacency strategy*: In parsing a noncompound sentence, starting from the left, group together as constituents of the same construction two adjacent NPs (i.e., not separated by other NPs) and an adjacent, noninitial, verb that has not already been assigned to a clause. Interpret the first NP as the subject of the verb, and the second NP as the object of the verb. (1977, p. 312)

A relative clause structure containing a transitive verb has three full NPs in the surface structure. Therefore, subjects must recover the fourth NP from the sentence to make two propositions from the relative clause structure, thus assigning two functions to one of the three NPs. Sheldon

argues that the subjects in her study tend to assign the function to the respective NP as the Adjacency strategy above suggests. For example, given an SS type sentence, "The boy that saw the girl hit the man," the strategy parses the first NP "the boy" and the second NP "the girl" as the subject and the object of the first verb "saw". Next, the second NP is employed again with the third NP to isolate the second proposition, interpreted as the subject and the object of the second verb "hit", respectively. Sheldon analyzed four types of English relative clauses according to the Adjacency strategy. The only type in which the Adjacency strategy predicts correct response patterns both in the main and relative clauses is the OS type. The prediction for the SS type is wrong in the main clause, while for the OO type the strategy does not predict the correct order in the relative clause: the prediction for the SO type fails in both clauses. It was indicated that the predictions were born out by the clausal performance score. Sheldon points out that errors made by the Adjacency strategy were most frequent and consistent across SO, OO and SS types, thus claiming that the subjects overuse the Adjacency strategy. However, those errors account for only 30 percent of the total errors in three sentence types above, and consequently it is not clear that adults necessarily overrely on the Adjacency strategy.

2.4 Developmental Studies

In the previous section adults' comprehension of relative clause structures was discussed. An interesting question is whether the relative complexity of the four types of relative clauses treated in the studies is reflected in the child's acquisition of those structures. Considerable research has been carried out to investigate the developmental order of relative clause structures across languages (e.g., Brown, 1971; Noizet, Deyts & Deyts, 1972; Cook, 1975; Sheldon, 1974; M. Smith, 1974; Harada et al., 1976; Lynkowsky, 1980). Fairly consistent results appear as to the acquisition of English relative clauses, which tend to correspond to the results of adult studies (e.g., Brown, 1971; Smith, 1974), suggesting that adults and children have the same type of difficulty in the comprehension of relative clause structures. What about processing strategies, then? Attempts have been made to discover the processing strategies children use in parsing relative clause structures. The procedures used to explore the child's processing strategies are much the same as those used in adults'studies, namely, those in which the responses of comprehension or/and production are analyzed in terms of a sequential order or according to the grammatical functions of words in sentences (e.g., Sheldon, 1974; M. Smith, 1974; Harada et al., 1976).

Recently, Prideaux (1979) proposed that the acquisition of relative clause structures can be placed into a general

developmental perspective. He formulated a set of developmental principles based on Slobin (1973), which are applicable to language learning in general. Predictions as to the developmental order of relative clauses are made based on the principles. Prideaux argued that the predictions were born out by empirical data, suggesting that the developmental principles are operative in the aquisition of relative clauses. In this section, I will review the developmental principles and discuss developmental studies of English relative clause structures in terms of those principles.

Based on many cross-linguistic studies, Slobin (1973) proposed the primacy of cognitive over linguistic development. That is, he suggested that the cognitive development of the child is prerequisite to linguistic development. Slobin noted that children start to express the same kinds of ideas at about the same time, and the ideas expressed follow the same order of development across languages. For example, Slobin claims that children begin to express locatives first in two-word combinations at the two-word stage in all languages. In addition, the order of development of locative notions, from simple topological notions to notions of dimensional space, seems uniform across languages, which, he argues, must be determined by cognitive development. Given cognitive precedence, Slobin assumes that forms which express cognitively complex notions appear later in language development. Hence, the first

developmental principle, "cognitive precedence", states that cognitively simpler forms appear before complex ones.

Concerning the mapping of concepts onto forms, another developmental principle is proposed by Slobin: "New forms first express old functions, and new functions are first expressed by old forms" (p. 184). Slobin claims that numerous developmental studies support the principle, a well-known principle in cognitive psychology. This principle, which Prideaux labels "functional exploitation", states that new functions are first expressed by old structures. This serves as the second basic principle.

If cognitive development sets the pace for linguistic development, and if the stages of cognitive development are uniform across languages, then the rate and order of development of meaning expressed by languages should be uniform. However, as observed in the following example of Egyptian Arabic plural forms (Slobin, 1973, p. 181), the formal complexity of languages in expressing given semantic notions affects the child's aquisition of linguistic forms. The plural forming system of Egyptian Arabic is apparently so complicated compared to that of English that even 15-year-old children are reportedly unable to master it fully. Thus, cognitive complexity refers to contents which underlie forms and to forms themselves as well. Consequently, Slobin argues, on comparing cross-linguistic data, we should be able to identify the complexity of formal devices and discover which formal properties are hard to

acquire. In addition, by identifying devices this way, it may be possible to uncover the child's processing strategies. The analysis of studies addressing some forty languages led Slobin to propose the following strategies or "operating principles":

A. Pay attention to the ends of words.

B. The phonological shape of words can be systematically modified.

C. Pay attention to morpheme and word order.

D. Avoid interrupting or rearranging linguistic units.

E. Semantic relations should be overtly and clearly marked.

F. Avoid exceptions.

G. Grammatical markers should make semantic sense.

Prideaux formulated two more principles, "grammatical uniqueness" and "structural integrity" out of the operating principles above. The four developmental principles which were used to analyze development of relative clause structures are summarized below:

Cognitive precedence. Cognitively simpler structures emerge before more complex ones.

Functional exploitation. New functions are first expressed by old structures.

Grammatical uniqueness. A grammatical marker initially and correctly identified uniquely with a particular function is not later readily adaptable to a different function.

Structural integrity. The structural integrity of linguistic units should be maintained.

Each principle is evaluated in terms of empirical data in the following.

2.4.1 The principle of cognitive precedence

The principle of cognitive precedence predicts early emergence of simple structures over complex sentences, since a simple sentence, in general, contains or represents one proposition and is consequently cognitively simpler. Given conjoined sentences and sentences containing relative clauses then, the principle predicts that conjoined sentences will appear first because these are combined in a sequential order, whereas in relative clauses one sentence is inserted into another sentence, resulting in more complex structures.

The appearance of conjoined sentences prior to relative clauses has been noted in several developmental studies. Limber (1973) investigated the development of complex sentences of 12 children of 1;6 (years;months) to 3;0 based on a longitudinal study. Data were collected by means of two tasks: spontaneous speech between parent and child, and experimenter-elicited speech. The sentences under consideration, however, were mostly obtained from spontaneous speech of three children. A chronological record of appearance of complex sentences clearly indicates that conjoined sentences emerged earlier than relative clauses. The first appearance of conjoined sentences was in the form of listing two simple sentences at the age of 2;0. Several

months later, conjoined sentences with a conjunction "and" appeared, closely followed by conjoined predicates as shown in the following (p. 181).

(4) You lookit that book; I lookit this book (age, 2 years;0 month)

(5) You play with this one and I play with this (2;8)

(6) I went to the aquarium and saw the fish (2;10)

Relative clause constructions emerged about the same time as the third type of conjoined sentences appeared. The relative clause structures observed in Limber's data happened to be OO types only, and no other types occurred. Limber, speculating about this lack of other relative clause types, noted the child's tendency to use names or pronouns as grammatical subjects, noun phrases on which a relative clause cannot be formed.

Slobin and Welsh (1973) also investigated the development of complex sentences in one child, "Echo", between the age of 2;3;2; and 2;5;3; (years;months;weeks). Elicited imitation was employed to assess the child's competence in sentence production. The rationale for using elicited imitation as a device to measure production was that immediate repetition can be characterized as recognizing, storing and reproducing sentences (Slobin & Welsh, 1973, p. 486). Since this process involves more operations than comprehension, imitation is supposed to be

more complex than comprehension.[3] In fact, a sentence is claimed by both Neisser (1967) and C. Smith (1970) to be held easily in short-term memory if the structure of the sentence is internalized. It can be said then that the child's ability to imitate sentences depends on his competence in comprehension and production. Suppose if the meaning which underlies a sentence is grasped by the child who is not yet capable of producing it, a repeated sentence may be expressed in the form which is already at his command, implying the operation of the principle of functional exploitation. Consequently, the outcome of imitation sheds light on the child's productive system at his current state.

By 2;3;3, Echo could imitate conjoined sentences if the two combined sentences were parallel in structure. At the same time, she was able to process sentences with conjoined NPs, although they were not stable enough to attain constant proficiency. A month later Echo was asked to imitate subject relative clauses. The results suggest that she understood the relative clauses, but reproduced them in the form of conjoined sentences, thus providing support for the principles of cognitive precedence and functional exploitation. Echo's imitation quoted below reveals her control of complex sentences at age of 2;4;3. The first sentence is a model sentence and two successive sentences

---

[3]It is noted that rote repetition is possible when a given sentence is short or not too complex (Maratsos & Kuczaj, 1974).

are imitations:

(7) THE MAN WHO I SAW YESTERDAY RUNS FAST.

(8) I saw the man who run fast.

(9) I saw the man and he run fast. (2;4;3)

The above example indicates (a) Echo comprehends the meaning of the sentence, (b) her paraphrases of the sentence reflect the degree of ease of each sentence construction, (c) she has already mastered objective relative clauses, (d) relative clause structures on subjects are still expressed in conjoined sentences.

A developmental study of children's processing of complex sentences was also reported by C. Smith (1970). Her subjects were eighteen 3- to 4-year-olds whose speech samples were taken from natural speech and elicited imitation. Developmental trends discerned in the elicited imitation data are the same as those in other studies (e.g. Limber, 1973; Slobin & Welsh, 1973). As expected, conjoined sentences were easier than to repeat than relative clauses. Smith attributes uneven responses of relative clauses to the current stage of the child's linguistic development. That is, the child may comprehend the relative clauses although such sentences were seldom observed in natural speech. In contrast, conjoined sentences occur in natural speech -- an indication that the child can both comprehend and produce conjoined sentences.

All the studies hitherto reviewed have shown the early emergence of conjoined sentences over relative clauses, thus

supporting the principle of cognitive precedence (for further supporting evidence, see Sheldon, 1973 and M. Smith, 1974). Next, we turn to the discussion of the principle of grammatical uniqueness.

2.4.2 The principle of grammatical uniqueness

All the relative pronoun forms are not uniquely associated with the function of relative clauses. The overlapping of the relative pronouns with the interrogative pronouns such as *who*, *why*, *where*, *when* and *which* as well as the overlapping of the relative pronoun *that* with the demonstrative pronoun is discussed in Prideaux (1979). The only relative pronoun that does not share another grammatical function is Ø (deletion of the relative pronoun in object focus, the relative clause in which the object is relativized). While the interrogative pronouns and the demonstrative pronouns are expected to be acquired earlier than relative pronouns, the principle of grammatical uniqueness predicts that Ø should appear first among the relative pronouns. Limber's findings reviewed above corroborate the prediction, indicating that the first relative pronoun, Ø, appeared in object focus of object relative clauses, followed by the appearance of the relative pronoun *that* in the same position.

2.4.3 The principles of structural integrity and functional exploitation.

The principle of structural integrity makes the following two predictions with respect to the form of relative clause structures:

Interruption. Discontinuous structures are acquired after continuous ones: sentences of which related parts are separated will be relatively harder to process in comprehension and imitation.

Word Order. Sentences in which linguistic units are rearranged appear later in linguistic development, that is, the sentences in which the regular word order is preserved are easier to process in comprehension and imitation.

Concerning the order of the acquisition of relative clauses, Interruption suggests the appearance of right-branching relative clauses, (OS,OO types) before center-embedded structures (SS,SO types) because the former involve no interruption of the main clause. Next, the question arises as to which of the relative clauses emerges earlier, subject focus, in which the subject of the relative clause is relativized, or object focus, in which the object of the relative clause is relativized. According to Word Order, the object focus appears later than the subject focus because the object of the verb in the relative clause is positioned before the relative pronoun in object focus, thus resulting in the word order being rearranged. When Interruption and Word Order are taken together, the order of development of the relative clause structures in English is predicted to be OS>OO>SS>SO with OS types being the earliest

and SO types being the latest.

The previous review of developmental studies established the precedence of conjoined sentences over relative clauses. The principle of functional exploitation applied to the development of relative clauses then predicts that relative clauses are first expressed in the form of conjoined sentences. This is exactly what Slobin and Welsh found Echo's imitated speech of relative clause structures. The same tendency was observed by M. Smith (1974) in his elicited imitation experiment with small children, the results of which will be discussed shortly. It is then predictable that the relative clause structures which can be analyzed in the forms of conjoined sentences emerge earlier than those which cannot. The most basic English conjoined sentences involve a simple linking of two sentences: S V O *conj.* S V O. English also has conjoined sentences of conjoined NPs and conjoined predicates, the former in the form of S *conj.* S V O, and the latter, S V O *conj.* V O. The relative clause which could be modeled on one of these conjoined structures should be acquired earlier, according to the principle of functional exploitation. While candidates for the form of a simple linking of conjoined sentences are OS and OO types, SS types also have a conjunction prototype, namely, conjoined predicates.[4] Consequently, those three types are expected to emerge

---

[4] In fact, the Adjacency strategy proposed by Sheldon (1977) might as well be considered to be a strategy to parse a relative clause in the form of conjoined sentences.

early. There is no conjoined structure paralleling the SO type, so this type will be predicted to be acquired relatively later.

We now turn to the developmental studies which investigate the order of development of the four types of relative clause structures. None of the studies to be reviewed directly address the order of emergence of relative clauses in spontaneous speech. However, the studies suggest the order of complexity of the four types of relative clauses in comprehension and imitation of the sentences, thus revealing the child's competence in processing of relative clause structures.

Brown (1971) was the first researcher to formulate the four types of relative clause structures serving stimulus sentences and to investigate their developmental order. In his study, ninety-six 3-, 4- and 5-year-old chidlren were presented a pair of pictures for each stimulus sentence and were instructed to identify the correct referent of the sentence. Brown's findings revealed that while no overall difference was observed between center-embedded and right-branching structures, the former were easier than the latter for three-year-olds, but with the reverse results for older children. Since the overall correct responses of subject focus were far higher than those of object focus in center-embedded relative clauses, the type SS might be the first of the four types of relative clauses to be learned. In fact, the experimentally obtained order of ease of

comprehension, SS>OS>OO>SO, was claimed by Brown to be found at all age levels. Brown attributed the ease of processing of SS types to the possibility that the three- to five-year-old is generally inattentive to the function of the relative pronoun, and consequently he might assign the structure of conjoined sentences to relative clause structures. In particular, the SS types, with deleted relative pronouns, resemble conjoined predicates, thus facilitating the conjoined sentence strategy. I will return to this point shortly.

The child's comprehension of four types of relative clauses was also investigated by Sheldon (1975) by means of a toy manipulation task. Thirty-three children from 3;8 to 5;5 (years;months) were asked to act out sentences with toys immediately after the presentation of simulus sentences. The sentences used consisted of relative clauses and conjoined sentences. As expected, conjoined sentences were easier to understand than relative clauses. Overall correct responses of the four types of relative clauses is SS>OO>OS>SO. OO types are easiest in the youngest group (3;8-4;3), whereas the oldest group (5;0-5;5) favoured SS types. Since SS,OO types were found to be far easier than SO,OS types, Sheldon rejected the Interruption Hypothesis and the Word Order Hypothesis, both of which were derived from Slobin's operating principles as indicated above. Instead, Sheldon attributed the results to a "Parallel Function Hypothesis", which states the relative clause structures in which the

function of coreferential NPs in the main and relative clauses are the same are easier than those in which the function of coreferential NPs are different. This hypothesis is criticized in Prideaux (1979), where it is argued that the hypothesis has no substantive content other than renaming the results. Moreover, the hypothesis also seems to contradict Brown's (1971) suggestion that the small child might be inattentive to the function of the relative pronoun. When the relative pronouns are deleted from relative clause structures, the resulting structures may look like the following (Brown, 1971, p. 1931):

(10) SS: S-V-O-V-O

(11) SO: S-S-V-V-O

(12) OS: S-V-O-V-O

(13) OO: S-V-O-S-V

If the child does not understand the function of the relative pronoun, he may not know the meaning which underlies the structure. Therefore, he must rely on the form of the structure. The established fact that the child has already acquired conjoined sentences allows him to parse the relative clause structures as if they are conjoined sentences. In this regard, note that a sequential order of elements in SS types and OS types matches that of conjoined predicates. If the child assigns the structure of conjoined predicates to those types, it yields correct parsing for SS types, but incorrect parsing for OS types. This is exactly the trends observed in Sheldon's data. Sheldon examined the

response types of relative clauses and pointed out many "extraposition errors" in OS types, in which almost half of the children interpreted the relative clause as modifying the subject of the main clause rather than the object. In fact, what the child is overrelying on is not an extraposition rule as Sheldon suggests, but a conjoined predicate strategy as Prideaux (1979) points out. The child's overgeneralization of conjoined predicates to relative clause structures accounts for the fact that SS types obtained the most correct responses among the four types. Additional support for the claim that the child relies heavily on a conjoined predicate strategy is provided by a breakdown of all the responses on the relative clauses (Sheldon, 1974, p. 278).

Table 2.2

Breakdown of All the Responses on the Relative Clauses

	SS	SO	OS	OO
Correct	*52*	17	29	50
Extraposition	--	--	44	32
(only)	--	--	--	(22)
(and parallel function)	--	--	*(44)*	(10)
Parallel functions	14	*69*	14	*12*
Other	33	13	12	5

The digits in italics indicate the numbers of the responses analyzable as conjoined predicates. The response rate of

such strategies are the highest of all the responses in each type with the only exception of the OO types, and the OO types are analyzable as conjoined sentences. The data suggest clearly that the children in Sheldon's study overrely on the conjoined predicate strategy, thus supporting the principle of functional exploitation. High performance of OO types may be explained in the light of the results of Limber (1973). It was noted before that the OO types are the first relative clauses to emerge in Limber's data, which corresponds well to Sheldon's findings that the responses of these types are best among the smallest children. In fact, performance on OO types does not increase with age as much as that on SS types. As he gets older, the child is likely to shift his processing strategy and overgeneralize his current favorite strategy to other sentences.

Further research intended to investigate the developmental order of the relative clauses was carried out by M. Smith (1974). While Brown and Sheldon tested the child's comprehension of sentences, Smith investigated the child's competence of processing relative clauses using an elicited imitation technique. Smith's subjects were younger than those in the previous studies, ranging in age from 29 to 36 months. Stimulus sentences were the four types of relative clauses with nonsense NPs used in place of familiar NPs, such as the names of animals. The results revealed a consistent tendency to repeat relative clause structures in

the form of conjoined sentences, supporting the principles of cognitive precedence and functional exploitation. While no significant age group difference was observed in the performances of imitation of relative clauses, the data showed significant differences in two other factors: the position of a relative clause and focus. Right-branching relative clauses (SS,SO types) appeared easier than those of center-embedding (OS,OO types). Concerning focus, subject focus (SS,OS types) obtained significantly higher correct responses than object focus (SO,OO types). The results reflect the response tendency observed in Sheldon's (1977) study with adult subjects in which there were more mistakes due to object focus than due to center-embedding. The experiment did not corroborate Sheldon's Parallel Function Hypothesis since the correct response rate for SS,OO types was not significantly greater than that of the SO,OS types. The order of processing complexity of relative clauses in Smith's study is OS>SS>OO>SO in the order of increasing complexity. The ease of processing of OS,SS types over OO,SO types led Smith to propose that the child uses a combined strategy of Bever's (1970) NVN strategy and Rosenbaum's (1967) minimum distance principle (MDP). As discussed in the previous section, the NVN strategy parses the initial NVN sequence in the surface structure as "actor-action-object". Hence, while the three relative clauses of OS, OO and SS types are correctly processed by the NVN strategy (disregarding the relative pronoun in the SS types), the SO

types are incorrectly parsed. The MDP states that the NP immediately preceding a relative clause serves as the subject of the relative clause, thus providing a correct interpretation of OS types, but an incorrect one for OO types. What is not clear in Smith's argument is which of SS and OO types is less complex according to the NVN strategy and the MDP. The NVN and the MDP parse the initial NVN sequence of SS types correctly, but both strategies claim nothing about the sequence of elements in the main clause. Apparently, Smith realizes the shortcoming of those strategies concerning the processing of SS types because he introduces an extra strategy "to insert the conj. 'and' and consider the subject of the main clause to also be the (extraposed) subject of the embedded clause (p. 106)." It is still not clear how this strategy facilitates the processing of SS types, and it gives the impression of being only an *ad hoc* correction. However, the order can be accounted for by the principles of functional exploitation and structural integrity. Both principles predict that OS types are less complex. The principles of functional exploitation predicts ease of processing of SS,OO types, whereas the principle of structural integrity predicts that OO types are more complex because of the perturbation of the internal order in the relative clause. Neither principle is applicable to the SO type because there is no conjoined prototype for it to be modeled on. Furthermore, the word order in the relative clause differs from the basic order, thus violating the

principles of structural integrity.

In this section the four principles have been evaluated in the light of experimental data, accompanied by the results that the principles are operative in the acquisition of English relative clause structures. Accordingly, it is interesting to ask whether these principles are applicable to the acquisition of relative clauses in other languages such as Japanese, where relative clause structures are syntactically very different from those in English. In the next section the cognitive principles will be examined in terms of Japanese developmental studies.

2.5 Japanese Developmental Studies

In this section, the predictions of the principle of cognitive precedence will first be evaluated in the light of data from Japanese developmental studies. None of the studies reviewed here directly address the acquisition of relative clause structures in spontaneous speech. Rather, they are devised to investigate the child's linguistic competence in comprehension and imitation of sentences. Consequently, as in the studies dealing with the acquisition of English relative clauses, the results may not reveal the order of acquisition of the structures, but may shed light on the child's competence in sentence processing.

As in English, the principle of cognitive precedence leads one to expect the early emergence of simple sentences. Developmental studies confirm this prediction, indicating

that the child attains full comprehension of simple S O V structures by the age of six (Hayashibe, 1975; Sano, 1977). Secondly, the principle predicts the precedence of conjoined sentences over relative clauses. The prediction was supported by the study carried out by Harada et al. (1976), who investigated the child's comprehension of conjoined sentences (conjoined predicates) and four types of relative clauses. Ninety-eight children from 3;6 to 10;11 were asked to act out the sentences with toys. Harada et al. obtained far more correct responses for conjoined sentences than for relative clause structures. The comprehension of the conjoined sentences improves rapidly between the ages of five and six with almost complete understanding attained at seven, whereas the development of comprehension of the relative clauses is slow and correct responses are still only a little beyond a chance level at the age of ten, largely due to the difficulty of processing of center-embedded, object relative clauses.

While the principle of grammatical uniqueness is not applicable to the acquisition of Japanese relative clause structures, both the principles of structural integrity and functional exploitation bear on the development of relative clause structures. Japanese relative clauses are oppositely placed to their English counterparts so that center-embedded relative clauses are formed on the object rather than the subject of the main clause. The principle of structural

integrity predicts the structure which contains center-embedding is harder in comprehension than the one which does not. Hence, it is expected that SS,SO types are easier to understand than OS,OO types. The principle of structural integrity is further useful to distinguish between these two types. It was predicted in the development of English relative clauses that object focus is harder than subject focus because in the former the object of the verb in the relative clause is positioned before the subject and verb, thus resulting in a rearranged word order O S V. In Japanese the relativized NP is not permuted, but deleted. However, the internal structure of relative clauses resulting from the deletion of the relativized NP is important. While the structure of the relative clause in subject focus conforms to the normal order O V, where the object precedes the transitive verb, the structure in object focus corresponds to S V in which the subject directly precedes the transitive verb, thus leaving a syntactic gap between the subject and the verb in the relative clause. Since the relative clause in subject focus does not contain a gap, the principle of structural integrity applied to different foci predicts that subject focus is easier than object focus in Japanese relative clauses. The data from a developmental study discussed below provide support for the prediction. In summary, the principles predict developmental order of Japanese relative clauses as SS>SO>OS>OO.

Concerning the principle of functional exploitation,

the subject of the main clause in English SS types is also the subject of the relative clause so that the principle can apply to the structure, predicting the facility of processing this type. In Japanese, however, the subject of the main clause has no grammatical relation to the relative clause in center-embedded structures to which the principle of functional exploitation can not apply. The difficulty of processing of center-embedded structures is further aggravated by their structural similarity to conjoined predicates as observed below. The first sentence is a conjoined sentence and two successive sentences are OS and OO types of relative clause structures, respectively.

(14) S O V O V

zoo ga uma o osite inu o nadeta

(The elephant pushed the horse and patted the dog.)

(15) S (O V) O V

zoo ga uma o osita inu o nadeta

(The elephant patted the dog that pushed the horse.)

(16) S (S V) O V

zoo ga uma ga osita inu o nadeta

(the elepahnt patted the dog that the horse pushed.)

The same sequential order of NPs appears in conjoined predicates and in center-embedded, object relatives. In the OS types in particular, not only the sequential order of NPs but that of particles is the same, with only a difference in

verb forms: in the OS types the verb takes the finite form, while in the conjoined predicates it takes the verb+*te* form. It is quite likely that this formal similarity leads the child to interpret object relatives as if they are conjoined predicates, when he does not yet grasp the meaning of this sentence type.

We now turn to the review of the developmental study of relative clause structures. First, however, a brief review will be made of an experimental study which provides support for the claim that the relative clause which has a syntactic gap is harder to process than the one which does not.

The study conducted by Sano (1977) investigated comprehension and imitation of simple active and passive sentences as well as cleft sentences. Subjects were 80 children whose ages ranged from 3;3 to 6;8. A toy manipulation task was employed to measure comprehension. Stimulus sentences consisted of (a) simple S O V sentences, (b) the corresponding passive sentences, (c) cleft sentences of active and passive voices and (d) sentences of the permuted word order of (a) and (b). In addition to these sentences, sentences without particles were also presented. The results of cleft sentences are shown below.

A Japanese cleft construction is represented in the following form.

(17) [NP1 V+*no*] *wa* NP2 *da*

Given the S V O sentence, "John ga Bill o osu (John pushes

Bill)", its subject-clefted and object-clefted analogues are as follows:

(18) Bill o osunowa John da (subject-clefted)

(19) John ga osunowa Bill da (object-clefted)

The results of both comprehension and imitation of cleft sentences indicated that subject-clefted sentences were easier than object-clefted ones in comprehension and imitation. While correct responses of the object-clefted sentences were less than 60 percent at the age of six, the subject-clefted sentences were remarkably well understood by the child of 4-year and 5-year-old, attaining complete comprehension of the sentence at six. Although the imitation score is lower than that of comprehension, the trends are the same as those in comprehension. Sano interpreted the results as due to the child's adoption of the strategy to regard the NP following the verb as an agent, attempting to make a general statement about phenomena common in sentence processing of English cleft constructions reported in Bever (1970) and in her study.[5] However, the results can be interpreted otherwise: the NP preceding the main verb is regarded as the object. Additional support for the child's tendency to interpret the NP immediately preceding the verb as the object is provided with the results of comprehension and imitation of sentences without particles of which sample sentences are given below. The first sentence is an S O V

---

[5]Sano's proposal seems ad hoc. An English subject-cleft sentence is easier, clearly because the order of the main constituents corresponds to that of a simple sentence.

sentence and three consecutive sentences are the types of the sentence without particles.

(20) John ga Bill o osu

(John pushes Bill)

(21) John Ø Bill o osu

(22) John ga Bill Ø osu

(23) John Ø Bill Ø osu

While the sentence (21) has no subject case marker, (22) has no object marker. The sentence (23) lacks both case markers. According to Sano, the children tend to insert the object marker *o* after the NP immediately preceding the verb in imitation. Thus, the resultant constructions always had *o* after the second NP regardless of the case marker of the first NP. The data suggest that the NP immediately preceding the transitive verb is regarded as the object. The results of a cleft sentence without a particle confirm the same tendency. The following form is a cleft sentence without a particle.

(24) John Ø osunowa Bill da

As discussed above, if the object marker *o* is inserted, the sentence is subject-clefted. On the other hand, if *ga* is inserted it becomes an object-clefted sentence. The analysis of data revealed that the child tends to place *o* in the blank. This tendency provides a strong support for the assumption that the child interprets the NP immediately preceding the transitive verb as the object because a sequence of constituents does not conform with that of an S

O V sentences, with two NPs separated by the verb.

These results all suggest that the child has a strong tendency to interpret the NP preceding verb as the object. Consequently, Sano's results indirectly support the claim that the sentence construction in which the subject is relativized (subject focus) is easier than object focus.

Returning to the discussion of the developmental order of relative clauses, I will examine the study carried out by Harada et al. (1976) in terms of the principles of structural integrity and functional exploitation. Their data strongly support the predictions of both principles, indicating the order of ease of comprehension as SS>SO>OS>OO. There is a large gap in comprehension between left-branching and center-embedded relative clauses, but with just slight difference observed between OS and OO types. The SS type is easiest to understand and its comprehension develops rapidly after six and reaches that of conjoined predicates at eight. For the SO type, the correct response rate is just the same as that of the SS type up to seven, but then declines suddenly after that age. The mistakes most commonly made in SO types by 8-year-olds or older are: (a) to regard the relativized NP as the subject of the relative clause, converting SO types to SS types and (b) to regard the subject of the relative clause as the subject of the main clause, thus assigning the structure of conjoined predicates to the SO type. Harada et al. assumes

that the children adopt a "Parallel Subject Strategy" which states "if a certain NP is identified as a subject, that NP is assumed to function as the subject for both clauses" (p. 211). The errors described above are attributed to the Parallel Subject Strategy. However, the results may also be explained as due to overgeneralization of SS types or conjoined predicates to SO types. Furthermore, if the relativized NP is not correctly parsed in the relative clause, (a) is the only alternative interpretation left.

Comprehension of object relatives was never beyond a chance level at the age of 10, suggesting the considerable difficulty of processing these sentences. As predicted, mistakes of object relatives caused by formal similarity to conjoined predicates were observed especially often among young children. Harada et al. termed these errors as "C-errors" (conjoined sentence type errors) and compared their response pattern with that of conjoined predicates. The analysis indicates that the pattern of C-errors parallels that of the correct responses of conjoined predicates until the age of six, followed by a sudden decline of C-errors after eight, suggesting that the child over eight starts to distinguish the object relatives from the conjoined predicates.

Another developmental study of Japanese relative clause structures is reported in K. Harada (1976). Harada attempted to investigate the imitative competence of relative clauses of her two-year-old daughter. Her findings have shown the

four types in the order of SS>>SO>OS>OO. The processing of any relative clause structures seems very hard for a two-year-old. Harada reported that she employed nonreversible sentences as stimuli, which explains the subjects' extraordinarily good performances for her age.

In summary, the predicted order of SS>SO>OS>OO was supported by the developmental studies of Japanese relative clause structures. The fact that the predicted order was confirmed suggests that the principles of both structural integrity and functional exploitation can account for the development of relative clause structures in Japanese.

2.6 The Motivation and Objectives of the Present Study

Japanese developmental studies supported the supposition that the cognitive principles can predict the order of ease of comprehension of relative clause structures. The early development of the ability to comprehend conjoined predicates provides support for the principle of cognitive precedence, whereas the development of relative clauses corroborates the prediction of the principles of both structural integrity and functional exploitation, confirming the predicted order of SS>SO>OS>OO. It can be concluded then that the cognitive principles are operative in the acquisition of Japanese relative clause structures. In the studies reviewed, however, only comprehension was examined on a large sample. Data available on production come from a study involving a single very

young child. Accordingly, the present study is designed to investigate the developmental order of Japanese relative clause structures, replicating the study of Harada et al.(1976) and extending it further in providing data from production by means of elicited imitation. The following hypotheses are formulated as to the developmental order of relative clause structures.

Hypothesis 1: Left-branching structures (SS,SO types) arise earlier in comprehension and imitation than center-embedded structures (OS,OO types).

Hypothesis 2: Subject focus (SS,OS), in which the subject of the relative clause is relativized, arises earlier in comprehension and imitation than object focus (SO,OO types), in which the object of the relative clause is relativized.

The both hypotheses are derived from the principle of structural integrity. The study reported here tests these two hypotheses experimentally.

3. THE EXPERIMENT

3.1 Introduction

This chapter is devoted to the description of the experiment which was conducted to investigate the order of the acquisition of Japanese relative clause structures.

The two operational hypotheses were formulated as follows:

Hypothesis 1: The number of correct responses to left-branching structures (SS,SO types) is greater in comprehension and imitation than that of center-embedded structures (OS,OO types).

Hypothesis 2: The number of correct responses to subject focus (SS,OS types), in which the subject of the relative clause is relativized, is greater in comprehension and imitation than that of object focus (SO,OO types), in which the object of the relative clause is relativized.

3.2 Subjects

The subjects selected for the experiment were sixteen Japanese speaking children, all of them residing in Edmonton, Alberta. The children were divided into four age groups: 5;00 to 6;00, 6;00 to 7;00, 7;00 to 8;00 and 8;00 to 9;00. Each group consisted of two males and females. All the

subjects were attending Edmonton public schools. In addition, fourteen of the sixteen children were attending the Japanese school once a week.

As for years of residency in North America among the children, fourteen out of the sixteen subjects were born and raised in North America, the remainer, the youngest two boys, residing there for less than two years.

3.3 Materials

In order to test the hypothesis, four types of relative clause structures (SS,SO,OS and OO types) were constructed. These sentences were similar to those employed by Uyeno et al. (1977). The names of animals and action verbs were adopted for NPs and verbs, respectively. In addition to the four types of relative clauses, conjoined sentences were also employed to test the principle of cognitive precedence, namely, the claim that conjoined sentences emerge earlier than relative clause structures. The conjoined sentences used for an experiment consisted of the following four types: (1) conjoined subjects (S *conj.* S O V), (2) conjoined objects (S O *conj.* O V), (3) conjoined predicates (S O V *conj.* O V) and (4) conjoined sentences (S O V *conj.* S O V). Altogether eight sentence types of relative clauses and conjoined sentences, four of each, were included in the experiment. The sentence types and examples are shown below:

Relative clause structures

Subject/Subject (SS):

inu o tobikoeta zoo ga saru o nadeta

(The elephant that jumped over the dog patted the monkey.)

Subject/Object (SO):

inu ga tobikoeta zoo ga saru o nadeta

(The elephant that the dog jumped over patted the monkey.)

Object/Subject (OS):

inu ga zoo o tobikoeta usagi o nadeta

(The dog patted the rabbit that jumped over the elephant.)

Object/Object(OO):

inu ga zoo ga tobikoeta usagi o nadeta

(The dog patted the rabbit that the elephant jumped over.)

Conjoined sentences

S *conj.* S O V:

zoo to saru ga inu o tobikoeta

(The elephant and the monkey jumped over the dog.)

S O *conj.* O V:

zoo ga inu to saru o tobikoeta

(The elephant jumped over the dog and the monkey.)

S O V *conj.* O V:

zoo ga uma o tobikoete usagi o osita

(The elephant jumped over the horse and pushed the rabbit.)

S O V *conj.* S O V:

uma ga usagi o tobikoete uma ga zoo o osita

(The horse jumped over the rabbit and the horse pushed the elephant.)

Sixteen stimulus sentences were constructed, two sentences for each sentence type. They were divided into two sets, each of which contained eight sentences. The order of the sentences was randomized in each set. The same sentences were used in both comprehension and imitation tasks. All the stimulus sentences are found in Appendix A.

3.4 Procedures

Two tasks were employed: a toy manipulation task and elicited imitation. The toy manipulation task was given first and the subjects' responses were recorded on the response sheet. In addition, an entire session of the toy manipulation and imitation was recorded for the analysis on a Sony cassette recorder (TC-1000B).

Each subject was tested for his comprehension, followed by imitation. Preceding the experiment, a practice session was carried out in which subjects were asked to identify animals and to act out simple sentences consisting of the animals and action verbs which were included in stimulus sentences. In the comprehension test the sentences were read twice. When a subject failed to respond to a sentence, it was repeated once at the end of the session. In imitation the toys were taken away and the sentences were read once. When the subject repeated a sentence verbatim, especially when that sentence was not acted out correctly, comprehension of the sentence was checked, asking "Who__whom?" Procedures taken for failed responses were the

same as those used in the comprehension task.

The data were scored as correct or incorrect in comprehension. Imitated speech was scored as correct, provided that sentence comprehension was correct. Rote repetitions without comprehension were not scored as correct responses.

The analysis of the data and discussion follow in Chapter IV.

4. RESULTS AND DISCUSSION

4.1 Introduction

Statistical tests were conducted to evaluate the experimental data. In this chapter the results of the statistical tests are first described and the hypotheses are evaluated. Secondly, the developmental principles are discussed in terms of the data. Thirdly, different results in the comprehension and imitation tasks are pointed out. It is suggested that different tasks reflect different developmental aspects of the child.

4.2 Results

4.2.1 Results of ANOVA

A four-factor analysis of variance was performed to investigate the effects of sentence type, task, sex and age. The eight sentence types were included in the experiment: four conjoined sentences (conjoined subjects, conjoined objects, conjoined sentences and conjoined predicates) and four relative clause structures (SS,SO,OS and OO types). These sentences were tested in both comprehension and imitation tasks. Subjects were divided into four age groups, ranging from five to eight years. The results of ANOVA are found in Table 4.1. Each main effect with the exception of sex was significant ($p < 0.01$). In

Table 4.1

Analysis of Variance

SOURCE	SUM OF SQUARES	DEG. OF FREEDOM	MEAN SQUARE	F
1 MEAN	288.0000	1	288.0000	
2 E TASK	24.5000	1	24.5000	80.705996**
3 S SEX	0.5000	1	0.5000	1.647061
4 A AGE	37.2500	3	12.4167	40.902128**
5 T SENTENCE TYPE	165.1250	7	23.5893	77.706039**
6 ES	0.5000	1	0.5000	1.647061
7 EA	1.7500	3	0.58333	1.921570
8 SA	6.7500	3	2.2500	7.411775**
9 ET	6.3750	7	0.910714	3.000003*
10 ST	5.1250	7	0.732143	2.411177
11 AT	23.1250	21	1.10119	3.627455**
12 ESA	1.7500	3	0.583333	1.921570
13 EST	3.8750	7	0.553571	1.823531
14 EAT	12.8750	21	0.613095	2.019610
15 SAT	18.1250	21	0.863095	2.843140*
16 ESAT	6.3750	21	0.303571	

addition, three first-order and one second-order interactions were significant: age by sex ($p < 0.01$), age by sentence type ($P < 0.01$), task by sentence type ($p < 0.05$) and sex by age by sentence type ($p < 0.05$). The Newman-Keuls (cf. Winer, 1971) test was employed for the purpose of testing the difference of the cell means for each significant effect. The results of the test are shown in Tables 4.2 through 4.5. The result of each test is reported below.

4.2.1.1 Age by Sex Interaction

The results of the Newman-Keuls test are given in Table 4.2. In general, performance increases with age with the exception of five- and eight-year-old girls (Figure 4.1). Five-year-old girls performed better than six-year-olds, whereas the performances of seven- and eight-year-old girls were the same. The results were apparently caused by a sampling imbalance since there was no significant overall difference between sexes. One thing to be noted is that there is marked growth of the performance observed at the age of six through seven. The older group of seven and eight appears to process these types of sentences far better than the younger group of five and six.

4.2.1.2 Age by Sentence Type Interaction

The results of the Newman-Keuls test are shown in Table 4.3. The interaction represented in Figure 4.2 clearly

Table 4.2

Newman-Keuls Comparisons of Means (Q Values)

for Age by Sex

	Male 5	Female 6	Female 5 Male 6	Female 7 Female 8	Male 7	Male 8
Male 5	———	2.7225	4.5374	9.0749**	10.8899**	13.6123**
Female 6		———	1.8150	6.3524**	8.1674**	10.8899**
Female 5 Male 6			———	4.5374**	6.3524**	9.0749**
Female 7 Female 8				———	1.8150	4.5374
Male 7					———	2.7225

(The numbers represent age.)

Table 4.3

Newman-Keuls Comparisons of Means (Q Values)
for Age by Sentence type

	5,OS,OO,SS 6,OS,OO 7,OS,OO	5, SO 7, SS 8, SO,OS,OO	5,SOV+OV 6,SOV+OV SS,SO	5,SOV+SOV 6,SOV+SOV 7,SO 8,SS	5,S+S	5,O+O 6,O+O	6,S+S	7,SOV+OV SOV+SOV 8,SOV+OV	8,SOV+SOV	7,S+S O+O 8,S+S O+O
5, OS,OO,SS 6, OS,OO 7, OS,OO	———	1.8150	2.7225	5.4449**	7.2599**	8.6174**	9.0749**	10,8898**	12.7048**	13.6123**
5, SO 7, SS 8, SO,OS,OO		———	0.9075	3.6299	5.4449**	6.3524**	7.2599**	9.0749**	10.8898**	11.7973**
5, SOV+OV 6, SOV+OV,SS,SO			———	2.7225	4.5374	5.4449**	6.3524**	8.1674**	9.9824**	10.8898**
5, SOV+SOV 6, SOV+SOV 7, SO 8, SS				———	1.8150	2.7225	3.6299	5.4449**	7.2599**	8.1674**
5, S+S	———	0.9075	1.8150	3.6299	5.4449**	6.3524**				
5, O+O 6, O+O		———	0.9075	2.7225	4.5374	5.4449**				
6, S+S			———	1.8150	3.6299	4.5374				
7, SOV+SOV, SOV+OV 8, SOV+OV				———	1.8150	2.7225				
8, SOV+SOV					———	0.9075				

(The symbols stand for sentence types. S+S:conjoined subjects, O+O:conjoined objects, SOV+SOV:conjoined sentences, SOV+OV:conjoined predicates, SS,SO,OS,OO: four relative clauses. The numbers represent age.)

Figure 4.1

Age by Sex

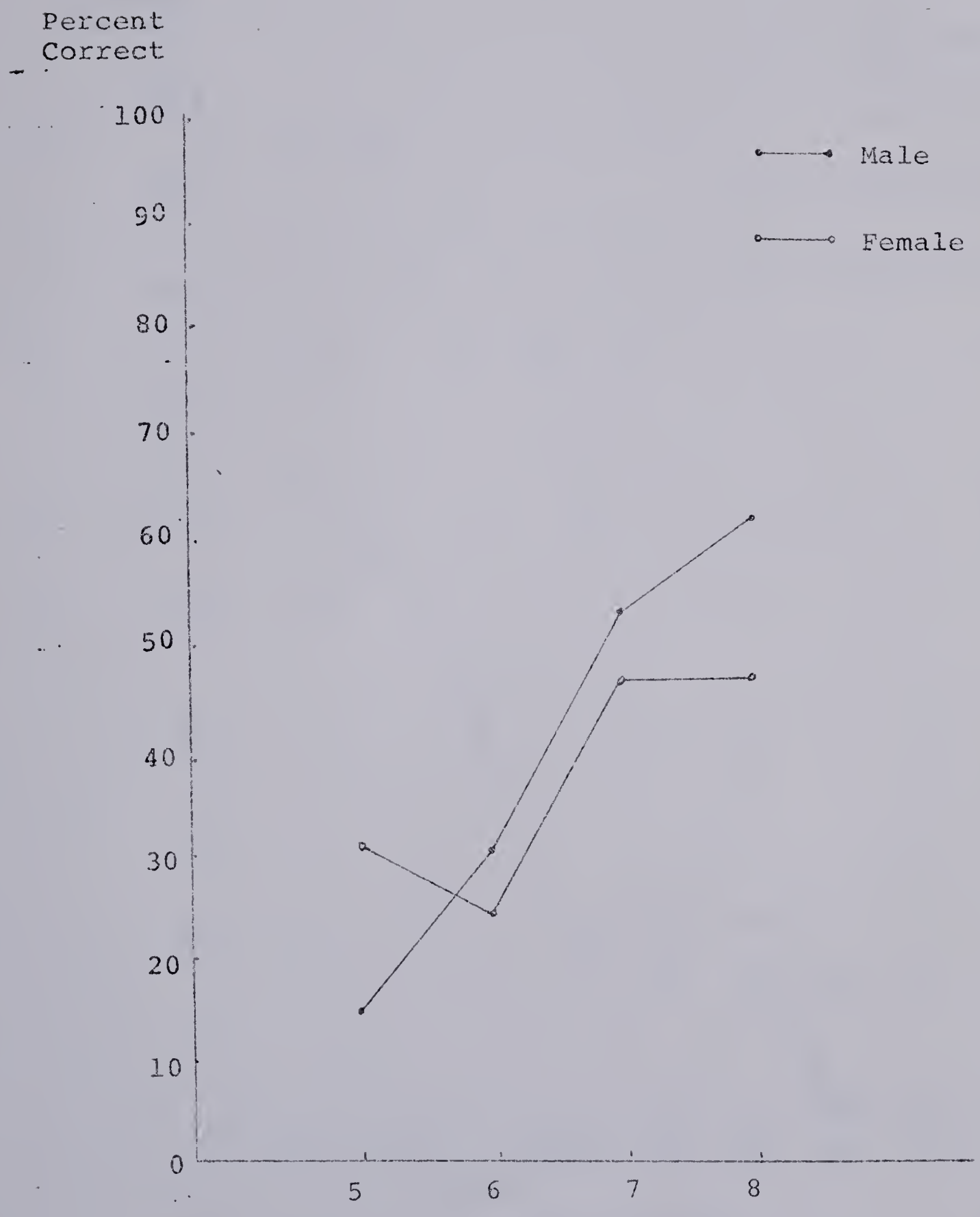
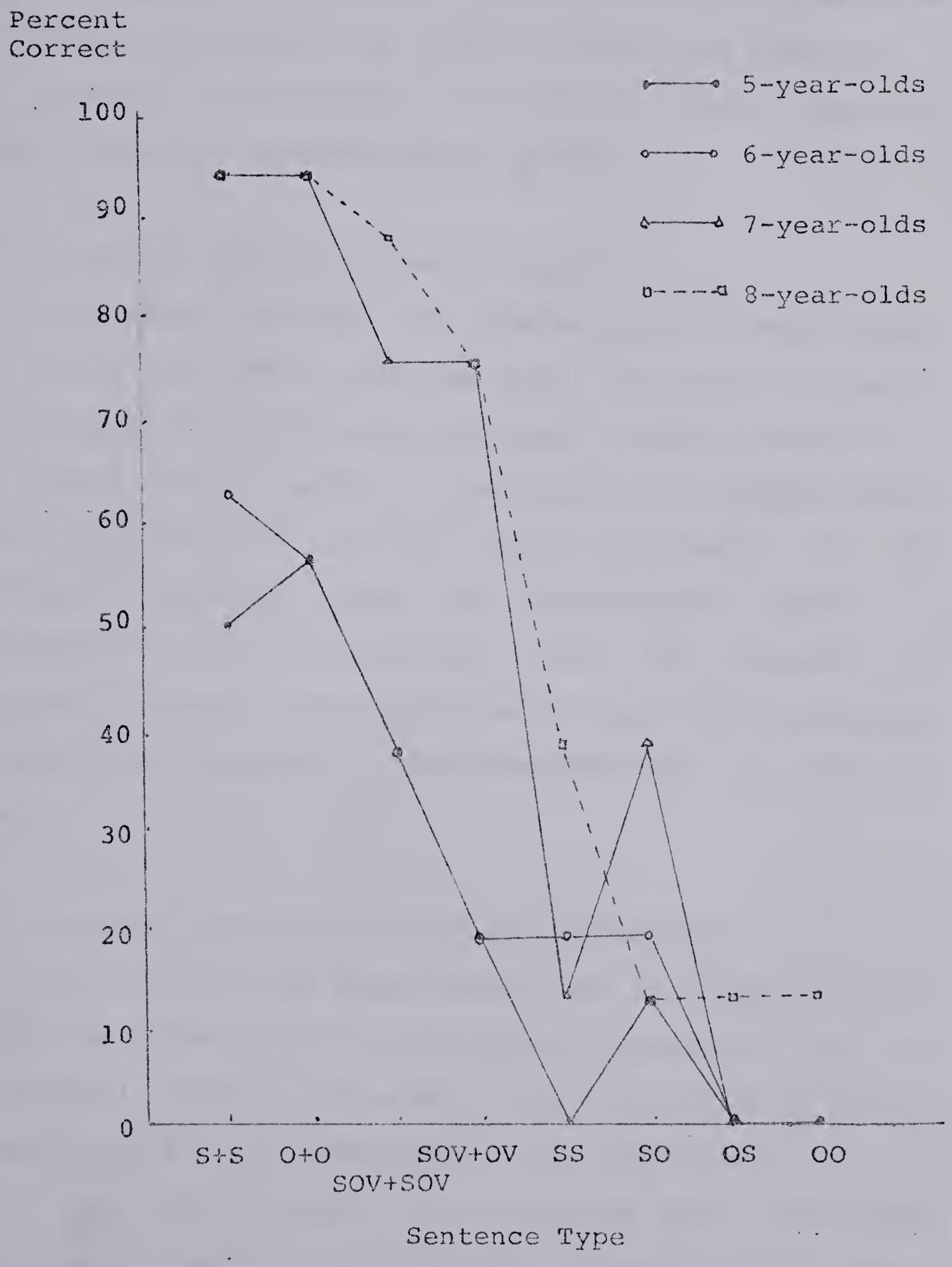


Figure 4.2

Age by Sentence Type



demonstrates the different patterns of performance of the two groups (the older and younger age groups), as mentioned above. The difference is mainly due to the results of conjoined sentences, showing a considerable gap between the two groups. In contrast, no such difference was observed in the subjects' performances of relative clauses, where few correct responses appeared across groups.

4.2.1.3 Task by Sentence Type Interaction

As is shown in Figure 4.3, comprehension is much easier than imitation for all sentence types. The order of ease of processing of the eight sentence types is fairly similar in both tasks. The results of the Newman-Keuls comparison of means in Table 4.4 indicate that performance on all conjoined sentence types is significantly better in comprehension than in imitation, with the exception of conjoined subjects. Performance on SS type relative clauses is significantly better in comprehension than in imitation as well.

4.2.1.4 Sex by Age by Sentence Type Interaction

The results of the Newman-Keuls test are shown in Table 4.5 and the interaction is presented in Figures 4.4 and 4.5. The general trends reflected in the interaction of age by sentence type are also observable for both sexes. As is clear from the figures, five-year-old girls performed significantly better on conjoined subjects than boys,

Table 4.4

Newman-Keuls Comparisons of Means (Q Values)

for Task by Sentence Type

	I,OO I,OS	I,SS	C,OO C,OS	I,SO	C,SO	I,SOV+OV C,SS	I,SOV+SOV	I,O+O	C,SOV+OV	I,S+S	C,SOV+SOV	C,S+S	C,O+O
I,OO OS	———	0.64	1.28	2.57	5.78**	6.42**	8.98**	11.55**	12.83**	13.48**	15.40**	17.33**	19.25**
I,SS		———	0.64	1.93	5.13**	5.78**	8.34**	10.91**	12.19**	12.83**	14.76**	16.68**	18.61**
C,OO OS			———	1.28	4.49	5.13**	7.70**	10.27**	11.55**	12.19**	14.12**	16.04**	17.97**
I,SO				———	3.21	3.85	6.42**	8.98**	10.27**	10.91**	12.83**	14.76**	16.68**
C,SO					———	0.64	3.21	5.78**	7.06**	7.70**	9.63**	11.55**	13.48**
I,SOV+OV C,SS	———	2.57	5.13**	6.42**	7.06**	8.98**	10.91**	12.83**					
I,SOV+SOV		———	2.57	3.85	4.49	6.42**	8.34**	10.27**					
I,O+O			———	1.28	1.93	3.85	5.78**	7.70**					
C,SOV+OV				———	0.64	2.57	4.49	6.42**					
I,S+S					———	1.93	3.85	5.78**					
C,SOV+SOV						———	1.93	3.85					
C,S+S							———	1.93					

(C stands for comprehension and I for imitation, respectively)

Table 4.5

Newman-Keuls Comparisons of Means (Q Values)
for Sex by Age by Sentence Type

	M,5,SS,SO OS,OO 6,OS,OO 7,OS,OO M 7,OS,OO 8,OS	F,5,SS,OS,OO 6,OS,OO 7,OS,OO	M,5,S+S SOV+OV 7,SS 8,SO,OO	F,6,SOV+OV SS,SO 7,SS,SO 8,SS,SO,OO	M,5,SOV+SOV 6,SOV+OV SOV+SOV SS,SO	F,5,SOV+OV SO 8,OS	F,5,O+O SOV+SOV 6,S+S,O+O SOV+SOV 8,SOV+OV	M,5,O+O 6,O+O 7,SOV+SOV SO 8,SS	M,6,S+S 7,SOV+OV F,7,SOV+OV 8,SOV+SOV	F,5,S+S 7,S+S,O+O SOV+SOV 8,S+S,O+O	M,7,S+S,O+O 8,S+S,O+O SOV+SOV SOV+OV
M,5,SS,SO OS,OO 6,OS,OO 7,OS,OO 8,OS	F,5,SS,OS,OO 6,OS,OO 7,OS OO	————	1.2834	2.5668	5.1335**	6.4169**	7.7003**	8.9837**	10.2670**		
M,5,S+S SOV+OV 7,SS 8,SO,OO	F,6,SOV+OV SS,SO 7,SS,SO 8,SS,SO,OO		————	1.2834	3.8501	5.1335**	6.4169**	7.003**	8.9837**		
M,5,SOV+SOV 6,SOV+OV SOV+SOV SS,SO	F,5,SOV+OV SO 8,OS			————	2.5668	3.8501	5.1335**	6.4169**	7.003**		
F,5,O+O,SOV+SOV 6,S+S,O+O SOV+SOV 8,SOV+OV					————	1.2834	2.5668	3.8501	5.1335**		
M,5,O+O 6,O+O 7,SOV+SOV,SO 8,SS						————	1.2834	2.5668	3.8501		
M,6,S+S 7,SOV+OV	F,7,SOV+OV 8,SOV+SOV						————	1.2834	2.5668		
F,5,S+S 7,S+S,O+O,SOV+SOV 8,S+S,O+O								————	1.2834		

Figure 4.3

Task by Sentence Type

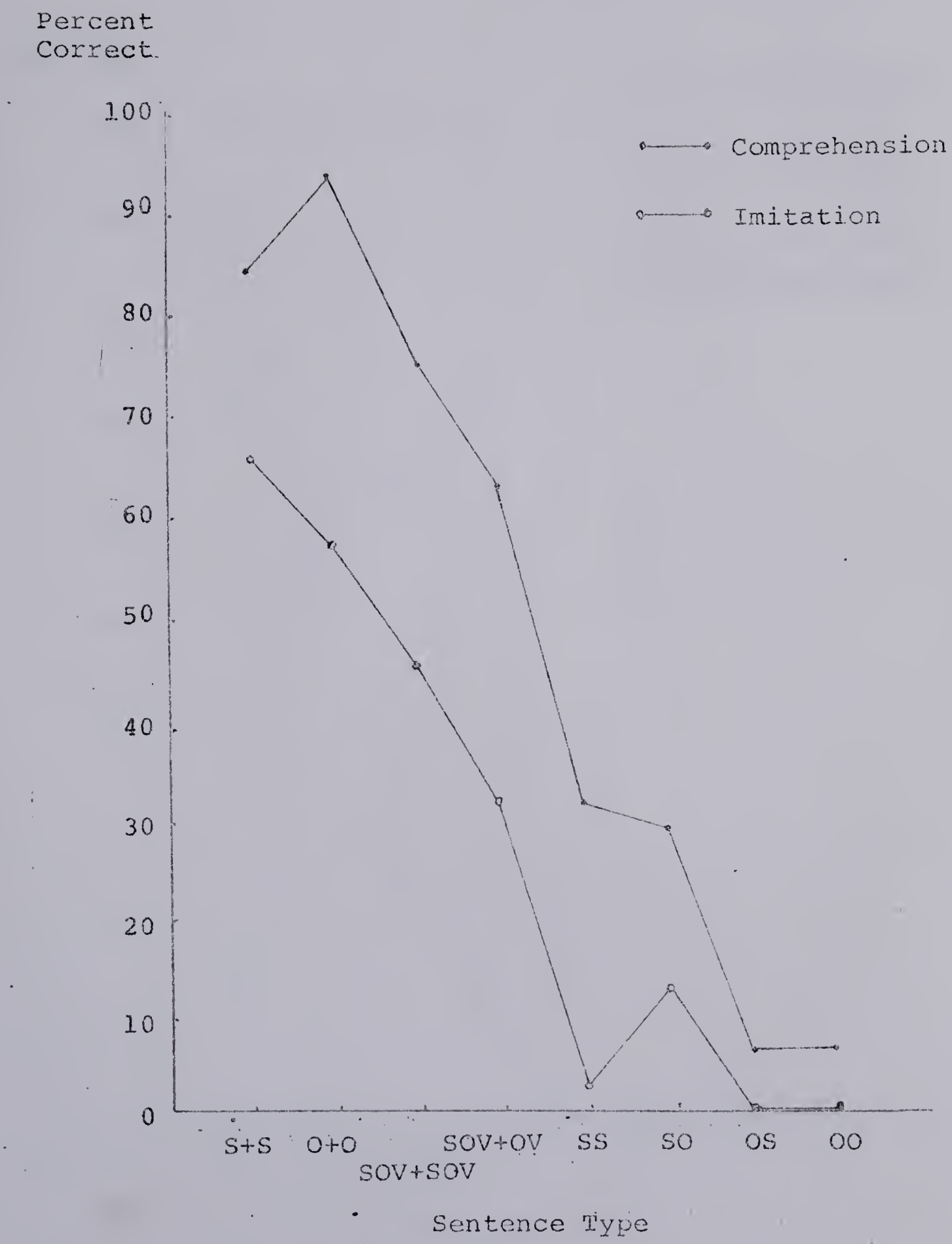


Figure 4.4

Sex by Age by Sentence Type
(Male)

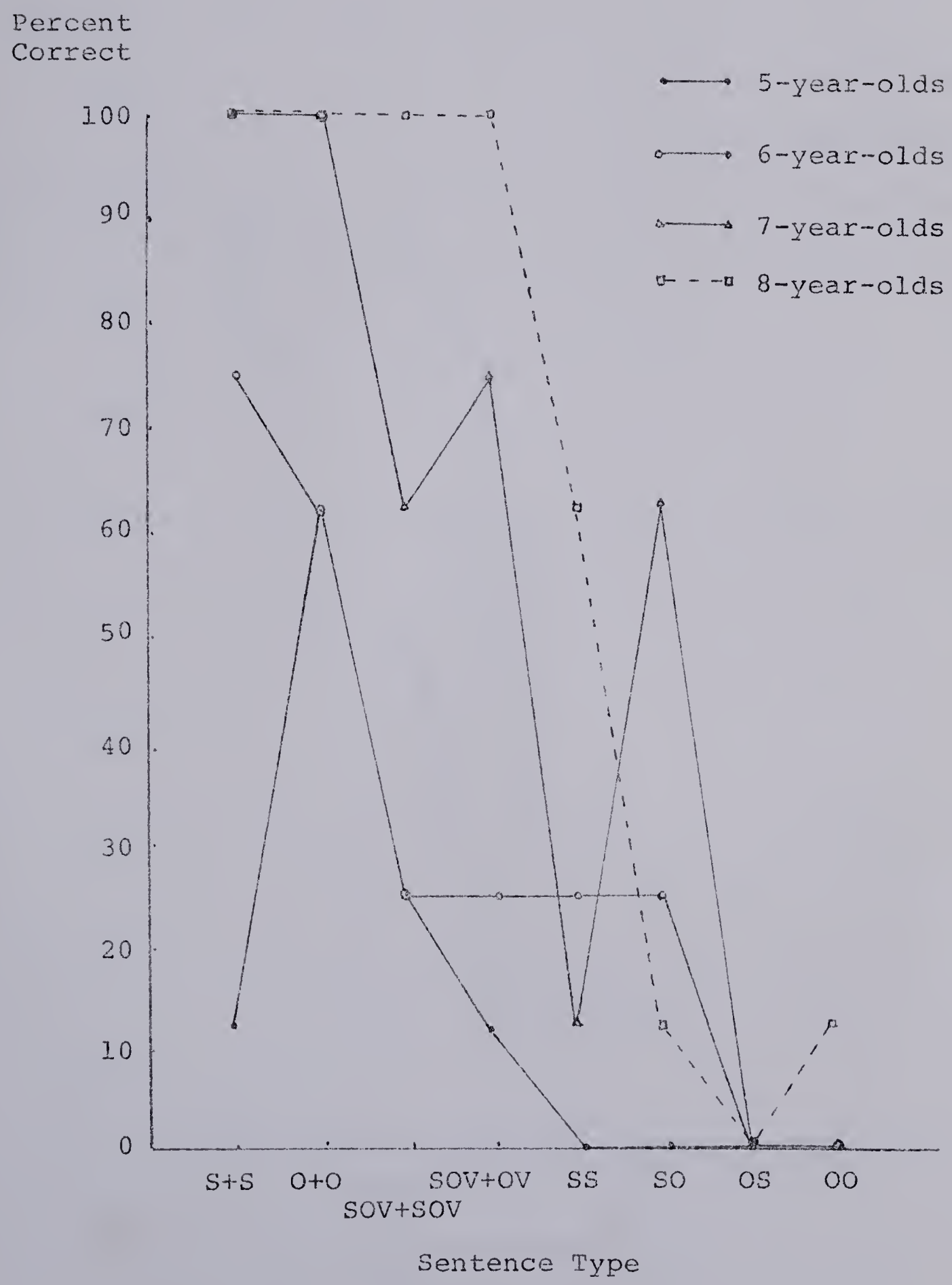
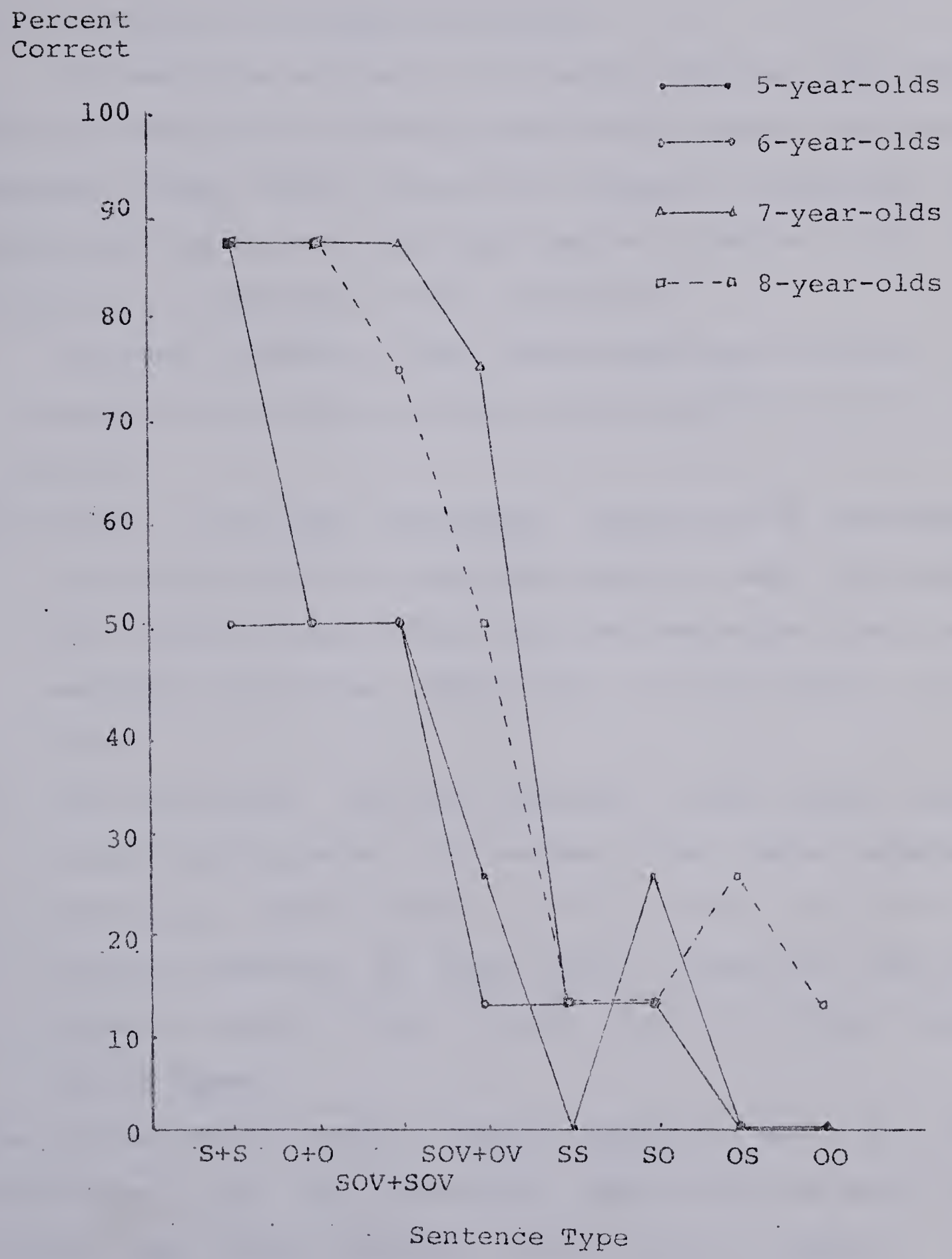


Figure 4.5

Sex by Age by Sentence Type
(Female)



eight-year-old boys performed better on conjoined predicates than girls and seven-year old boys performed better on SO type relative clauses than girls.

4.2.2 Results of Planned Comparisons

Following the analysis of variance, planned comparisons were carried out to determine specifically whether different sentence types have differential ease of processing. The following results were obtained from the combined data of responses of comprehension and imitation.

1. Conjoined sentence types were significantly easier to process than relative clause structures($F(7,21)=238$, $p < 0.01$).
2. Within conjoined sentences, conjoined NP sentences (conjoined subjects, conjoined objects) were processed significantly better than conjoined sentences (conjoined sentences, conjoined predicates) ($F(7,21)=20.18$, $p < 0.01$).
3. Left-branching relative clauses (SS,SO types) were significantly easier to process than center-embedded structures (OS,OO types) ($F(7,21)=10.29$, $p < 0.01$), whereas there was no significant difference observed between subject focus (SS,OS types) and object focus (SO,OO types).

The third result above clearly supports one of the hypotheses: that left-branching structures are easier to process than center-embedded constructions. However, the

hypothesis that subject focus is easier to process than object focus was rejected. When the comprehension and imitation data were analyzed separately, only comprehension results demonstrated the same trends as above. For the imitation task, conjoined sentences are significantly easier to imitate than relative clauses, and conjoined NP sentences were imitated better than conjoined sentences. Yet there were no significant differences for imitation among relative clause structures.

In summary, the main findings of the experiment can be stated as follows: performance generally improved with age, comprehension was better than imitation, conjoined sentences were easier than relative clauses. Among the relative clause structures, left-branching relative clauses were processed better than center-embedded structures, thus supporting the first hypothesis, that of non-interruption. The second hypothesis, which states that subject focused relative clauses are easier to process than object focused structures, however, is not supported by the data.

4.3 Analysis of Responses and Evaluation of Developmental Principles

In this section the responses to four types of relative clauses will be analyzed, and the developmental principles will be evaluated in terms of the data.

The principle of cognitive precedence predicts early development of conjoined sentences over relative clause structures. It was pointed out in Chapter Two that the principle is operative in processing of both types of complex sentences by English and Japanese children. The data from the present experiment support the principle as well. The results which are relevant in this regard are summarized as follows: (a) conjoined NP sentences are processed significantly better than conjoined predicates and conjoined sentences, and (b) the conjoined predicates and conjoined sentences in turn are significantly easier than relative clauses. Conjoined NP sentences which have a single verb are presumably simpler than conjoined sentences. As discussed, the latter are assumed cognitively simpler than relative clause structures since sentences are combined in a sequential order in conjoined sentences, whereas in relative clauses one sentence is inserted into another, resulting in more complex structures.

Once it is established that the principle of cognitive precedence is operative in explaining the results of the present experiment, a natural question is whether forms acquired earlier are employed in processing later, more complex forms.

As discussed earlier in Chapter Two, the principle of functional exploitation predicts that relative clauses are first expressed in the form of conjoined sentences.

Accordingly, the relative clauses which can be analyzed in the form of conjoined sentences develop earlier than those which cannot. Likewise, it can be argued that center-embedded structures may, in the early stages, be expressed by an existing form of relative clauses, presumably right- or left-branching structures. In fact, both instances are reported in English developmental studies (e.g., Slobin & Welsh, 1973). In Japanese, however, there is no relative clause which can be analyzed in the form of conjoined sentences. Although two left-branching types (SS,SO) have no interruption, the word order of the first clause of those types differs from that of conjoined sentences as illustrated in the following example (CS stands for conjoined sentences and CP for conjoined predicates).

(1) SS: [NP+*o* V] NP+*ga* NP+*o* V
RC

SO: [NP+*ga* V] NP+*ga* NP+*o* V
RC

OS: NP+*ga* [NP+*o* V] NP+*o* V
RC

OO: NP+*ga* [NP+*ga* V] NP+*o* V
RC

CP: NP+*ga* NP+*o* V+*te* NP+*o* V

CS: NP+*ga* NP+*o* V+*te* NP+*ga* NP+*o* V

In this regard, it was pointed out in the previous chapter that both OS and OO types bear structural similarity to

conjoined predicates. This structural similarity may lead the child to interpret center-embedded structures erroneously as if they are conjoined predicates. The strategy may be seen as an overgeneralization of earlier acquired forms, and can be subsumed under the principle of functional exploitation.

In the remainder of this section, the results will be discussed in respect to the following two questions:

(a) Does the child incorrectly assign the structure of conjoined sentences to relative clauses?

(b) Does he incorrectly assign the structure of left-branching relative clauses to center-embedded structures?

These questions can be answered if we examine the response patterns and try to detect some common mistakes caused by overgeneralization of earlier acquired forms.

Tables 4.6 and 4.7 summarize the main response patterns of all types of relative clauses in comprehension and imitation tasks, respectively. The notation adopted in the table follows that employed in other studies (Harada et al., 1976; Lynkowsky, 1980; Sheldon, 1972). The noun phrases are numbered in a sequential order as exemplified in the following sentence.

SS: inu o tobikoeta zoo ga saru o nadeta

dog jumped over elephant monkey patted

1 2 3

(The elephant that jumped over the dog patted the monkey.)

Table 4.6

Distribution of Responses to Relative Clauses

(Comprehension)

Type	Correct Response	Conjoined Analysis	SS Error	SO Error	Others
SS	21,23 (31.3%)	12,13 (12.5%)		12,23 (12.5%)	13,23 (6.3%) 21,13 (6.3%) 21,31+2 (6.3%
SO	12,23 (28.1)	12,13 (12.5)	21,23 (12.5)		12,31 (15.6) 13,23 (6.3)
OS	32,13 (6.3)	12,13 (50.0)		12,23 (12.5)	12,32 (9.4) 12,31 (6.3)
OO	23,13 (6.3)	12,13 (43.8)		12,23 (31.3)	

(The responses which exceed 5% are listed)

Table 4.7

Distribution of Responses to Relative Clauses

(Imitation)

Type	Correct Response	Correct Imitation Without Comprehension	Conjoined Analysis	SO Error	OS Error	Other		
SS	21,23 (3.1%)	21,23 (6.3%)	12,13 (9.3%)	12,23 (12.5%)		SV,OV (15.6%)	SV,SV (12.5%)	SVOOV (6.3%
SO	12,23 (12.5)	12,23 (9.3)	12,13 (6.3)			SV,SV (28.0)	SV,OV (9.3)	
OS	32,13 (0.0)	32,13 (12.5)	12,13 (18.8)	12,23 (6.3)		SOV+SOV(6.3) 12 23	SOOV (6.3)	
OO	23,13 (0.0)	23,13 (0.0)	12,13 (18.8)	12,23 (6.3)	32,13 (18.8)	SOV+SOV(12.5) 12 32 23		

(The responses which exceed 5% are listed with the exception of correct responses of SS types)

When the child understands the sentence correctly, he first has an elephant (2) jump over the dog (1) and then lets the elephant (2) pat a monkey (3). As a result, the order of the noun phrases acted out is 21,23. The first two digits correspond to the subject and object of the first clause; the last two digits represent the subject and object of the second clause. The numbers in the parentheses in the table indicate percentage of responses.

We have previously noted that relative clauses had very few correct responses in comprehension and imitation. In addition, an examination of Tables 4.6 and 4.7 reveals that the responses are quite varied, an indication that relative clauses were difficult to process for the children. In particular, the responses of the imitation task included many abbreviated and idiosyncratic forms.

As expected, mistakes caused by a conjoined clause analysis account for a majority of errors made for OS,OO types in comprehension. The same trends were observed to lesser degree in imitation. The conjoined clause analysis refers specifically to the strategy in which the first noun phrase of the sentence are regarded as the subject of both first and second clauses, corresponding to the interpretation of conjoined predicates in the present study. The comprehension data show that a conjoined error accounts for 50 per cent of OS types and almost 50 per cent of OO types. In imitation, the conjoined mistakes were also most

frequent response patterns for OS,OO types, although frequency was low. The children apparently rely on a previously acquired form, conjoined predicates, in processing center-embedded relative clauses. In contrast, few conjoined mistakes were observed on SS,SO types. Considering that the word order of the first clause of these types differs radically from that of conjoined predicates, it seems clear that the children are very attentive to the word order. If the word order of a relative clause is the same as that of conjoined predicates, a conjoined analysis is triggered to process the sentence. There was an instance in which one 7-year-old girl parsed seven out of eight relative clauses as conjoined predicates, although she was perhaps a rare exception. Perceptual saliency of the word order is also demonstrated in parsing of OO types, which contain a series of the same particles for the first two NPs: the normal word order of particles is NP+*ga* NP+*o* V, while in OO types the norm is NP+*ga* NP+*ga* V. The children ignored the deviant pattern of particles and processed these sentence as "normal" over 40 per cent of the time in the comprehension task. Likewise, in repeated speech a few children corrected the deviant series of particles into the regular one with verb intact, thus converting OO types to OS types.

The importance of word order is also noted by Lynkowsky in her study (1980) of Ukrainian children's comprehension of relative clauses. In Ukrainian all NPs are marked for

gender, number, and case. Therefore, Lynkowsky predicts that there should be no confusion as to grammatical functions. Yet the Ukrainian children in her study tended to utilize word order rather than morphological features as cues in parsing relative clauses.

It was remarked above that the word order of the first clause of both SS and SO types differs from that of conjoined predicates so as not to induce a conjoined analysis. Correct responses of SS and SO types were significantly higher than center-embedded (OS,OO) types, suggesting that the former constructions are easy. However, if children have not acquired a relative clause strategy to recover the deleted noun phrase, what would they do? Since there is no form to be modeled on, they should have difficulty in processing these forms. This may account for the variety of kinds of responses in SS and SO types.

It should be clear now that the child utilizes the structure of conjoined predicates in processing relative clauses, provided that the word order agrees with that of the conjoined predicates. The next question is whether the utilization of earlier acquired relative clauses is involved in the acquisition of later, more complex ones.

The examination of responses of OS and OO errors indicates that an SO error follows a conjoined analysis, particularly in processing OO types. A plausible explanation is that a repeated occurence of the particle *ga* evoked SO

type parsing since the latter also has the same series of particles for the first two noun phrases. A typical example is presented in the following imitated speech of an eight-year-old girl. In the repetition of OO types, she first repeated the sentence as an OS type, but then corrected it into an SO type.

(2) OO: inu *ga* zoo *ga* tobikoeta saru o nadeta
OS: inu *ga* zoo *o* tobikoeta saru o nadeta
SO: inu *ga* tobikoeta zoo *ga* saru o nadeta

Note that she maintains the original order of the three noun phrases in each repetition, although the meaning of the sentence is completely changed. Her repetition reveals the level of competence in linguistic development: she has not yet understood the OS or OO types, but she has mastered the SO types, which she then overgeneralized to other relative clause types.

The two hypotheses of the present study hinge on the principle of structural integrity. The principle led to the formulation of the hypothesis that left-branching SS,SO types are easier in processing than center-embedded OS,OO types. Another hypothesis states that subject focus (SS,OS types) is easier in processing than object focus (SO,OO types).

As shown above, the results corroborated the first hypothesis, but failed to yield support for the second hypothesis. The second hypothesis is supported by the

results of Harada et al. (1976) and K. Harada (1976). Harada et al. investigated comprehension of four types of Japanese relative clauses and found the order of ease of comprehension to be SS>SO>OS>OO, although there was little difference observed between OS and OO. K. Harada explored the imitative competence for relative clauses of her two-year-old daughter. Her findings indicated that SS types were far easier than other three types, in the order of SS>>SO>OS>OO. The hypothesis also explains Sano's (1977) experimental results of sentence comprehension and imitation. Her data demonstrated that children tend to interpret the noun phrase preceding the verb to be the object in cleft constructions, which exhibit a structural similarity to relative clauses in Japanese.

The results of the present experiment, however, did not support the hypothesis: the correct responses of SS types were not significantly greater than SO types in comprehension, whereas correct imitation of SS types was lower than that of SO types. There was no difference of response rates between OS and OO types in either task. Disregarding the two center-embedded types, which exhibited very few correct responses (4 out of 128 responses), the question remains as to why SS types do not induce more correct responses. Table 4.7 indicates that correct imitation of SS types not only was sparse, but there was no instance of an SS error on the other types. The only SS errors observed were for SO types in comprehension. In

contrast, SO errors occur in the other three types in both tasks. As discussed in Chapter Two, the data of Harada et al. (1976) demonstrated that the correct response rate of SO types is the same as that of SS types up to seven, but declines after that age largely due to an SS error. Since most of the children in the present experiment are under seven, the results may reveal a predominant strategy specific to this age group, namely, the strategy of treating a single NP preceding a transitive verb as the subject of the verb. A frequently-observed primitive strategy of simple sentences may be carried over to processing of embedded clauses of complex sentences.

Another possible cause of the overuse of the SO types may be attributed to interference from English. All of the children in the present study are bilingual with the exception of two youngest five-year-old boys. Accordingly, these children may have a tendency to interpret the noun preceding the verb to be the subject of the verb, in contrast to native Japanese children. The first clause in SO types allows the parsing of S V O from left to right just as in English. Consequently, a difficult construction for native Japanese children may not be so difficult for the bilingual children. A clarification on this matter depends on further studies with bilingual children in processing other sentence constructions such as cleft sentences and on experiments with older bilingual children.

In summary, the principle of structural integrity was found to be operative in the comprehension of Japanese relative clauses, thus asserting the predicted difficulty of center-embedded structures. However, the interruption of the main clause is not the only factor that affects parsing of center-embedded structures. As noted earlier, there is no such Japanese center-embedded relative clauses as English SS types which can be analyzed in terms of an earlier acquired form of conjoined predicates. The difficulty of center-embedded structures is further aggravated by their structural similarity to conjoined predicates, the interpretation of which was erroneously applied to the center-embedded structures by many children. Therefore, all these findings seem to indicate the operation of the three developmental principles of cognitive precedence, functional exploitation and structural integrity in processing Japanese relative clauses.

The data did not support the other hypothesis that subject focus is easier to process than object focus. The interruption of the main clause by another clause can be claimed to make sentence processing difficult for any child, whether he is English-speaking or Japanese-speaking. However, the hypothesis based on the word order which is specific to one language may not be workable to the children who are competent in another language as well.

4.4 Comprehension and Imitation Tasks

In the present study both comprehension and imitation tasks were employed in order to investigate the child's linguistic competence in processing relative clause structures. This section is devoted to the discussion of the different experimental results exemplified in those tasks and the accordingly different developmental aspects brought out by them.

In recent years numerous developmental studies have been conducted using naturalistic observation. The child's spontaneous speech was laboriously described on a longitudinal basis and many insights into the acquisition of the language resulted from the researches (e.g., Brown, 1973). Spontaneous speech, however, does not convey the whole picture of the child's linguistic competence. For instance, it is generally observed that comprehension precedes production. The need to confirm such an observation led researchers to adopt experimental methods other than naturalistic observation in developmental studies (cf., e.g., Fraser, Bellugi & Brown, 1963).

Another problem with naturalistic observation is that an instance of an expected sentence construction may simply not appear in spontaneous speech. Therefore, a proper experimental device to investigate the child's productive competence must be sought to supplement the data of naturalistic observation.

The rationale for using elicited imitation as a device to investigate productive competence was discussed in Chapter Two: imitated speech is retrieved from short-term memory where there is a good chance for a given sentence to be readily kept if the structure of the sentence has been internalized. That is, the child's ability to imitate a sentence depends on his competence in production as well as comprehension. The observation that imitated speech is quite consistent with the level of competence shown spontaneously is reported in many studies (Bellugi, 1971; Braine, 1971; Mcneill, 1970; Slobin & Welsh, 1973). Consequently, elicited imitation was employed in the present study to tap the child's current state of production.

If comprehension precedes production, comprehension results should be assumed to be superior to those of imitation. The data of this experiment supported this assumption. Comprehension is much easier than imitation for all sentence types. The order of ease of processing of eight sentence types is fairly similar in both tasks. However, the pattern of responses differed markedly. In imitation many reduced forms were observed, especially in SS and SO types. When relative clauses are imitated in the form of conjoined sentences, imitated speech should have the word order of NP NP V+*te* NP NP V, with the first NP functioning as the subject and the second NP as the object in both clauses. Instead, a typical reduced form shows a single NP in both clauses in the form of NP V+*te* NP V: an SS type such as *inu*

o tobikoeta zoo ga saru o nadeta (The elephant that jumped over the dog patted the monkey) would be imitated as *inu ga tobikoete saru ga nadeta* (The dog jumped over and the monkey patted).[6] Figures 4.6 and 4.7 represent the distribution of correct responses of SS and SO types in comprehension and imitation, respectively. None of five-year-olds correctly acted out the SS types, whereas there were few correct SO performances from the eight-year-olds. It appears that there was little difference in comprehension for both SS and SO types across three age groups with the exception of five-year-olds. In contrast to comprehension, not a single instance of correct imitation of the SS and SO types was observed for a younger group of five- and six-year-olds in Figure 4.7. Figure 4.8 demonstrates the frequency of errors among four age groups. The shadowed area represents the reduced responses categorized as others in Table 4.7 and the blank area corresponds to responses imitated in the form of relative clauses or conjoined sentences. The figures clearly indicate that the former type of imitation decreases with age as the latter increases. An interesting fact is that none of younger group of 5- and 6-year-olds imitated SS and SO types in the form of relative clauses or conjoined sentences. How can we explain such disparity? It was previously remarked that imitated speech reflects the level of linguistic competence in spontaneous speech. Since there

---

[6] A tendency that very young children treat transitive verbs as intransitive verbs in simple sentences are presented in various studies (e.g., Sinclair & Bronckart, 1972; Sano, 1977).

Figure 4.6

Frequency of Correct Responses
(Comprehension)

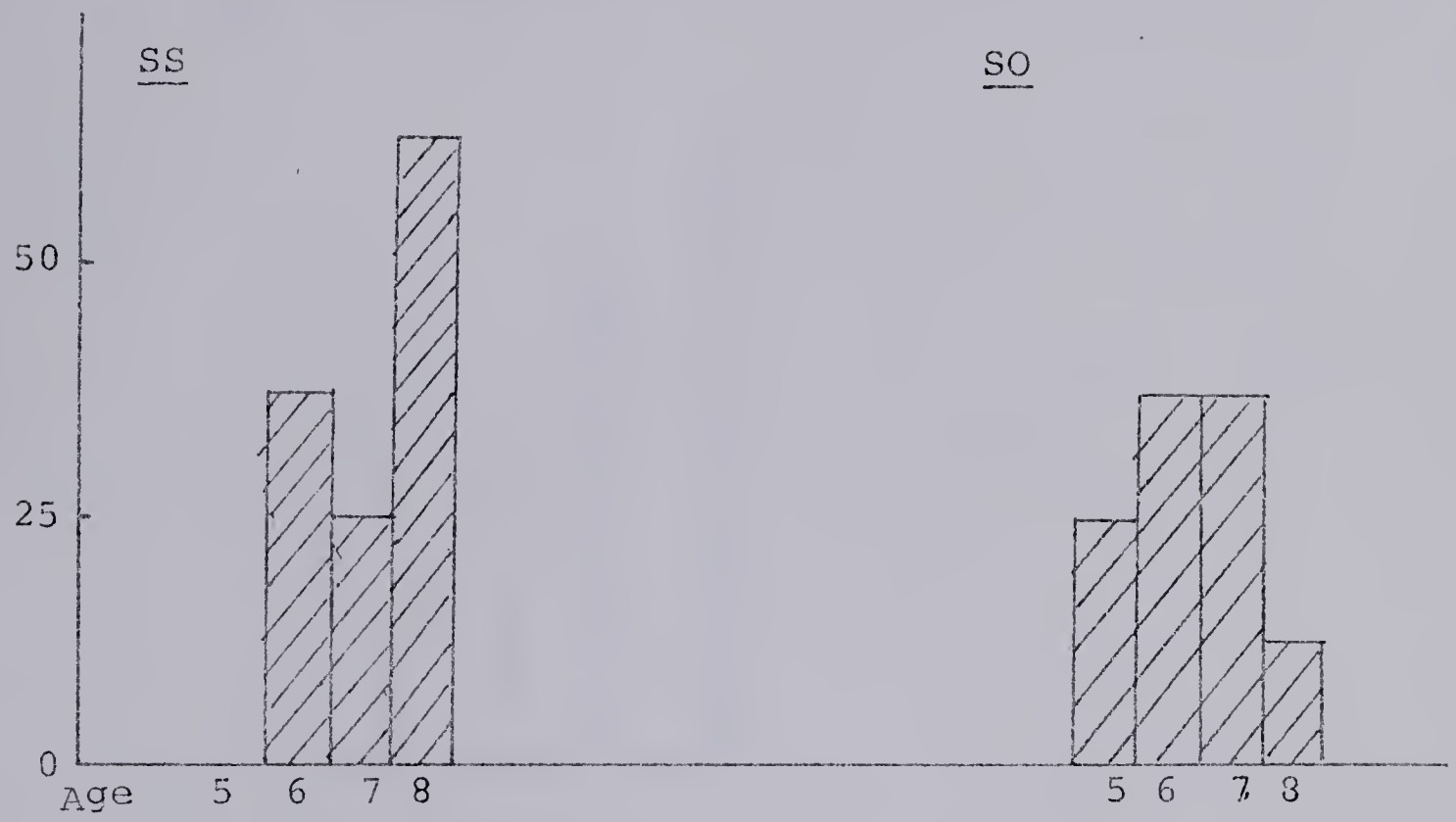


Figure 4.7

Frequency of Correct Responses
(Imitation)

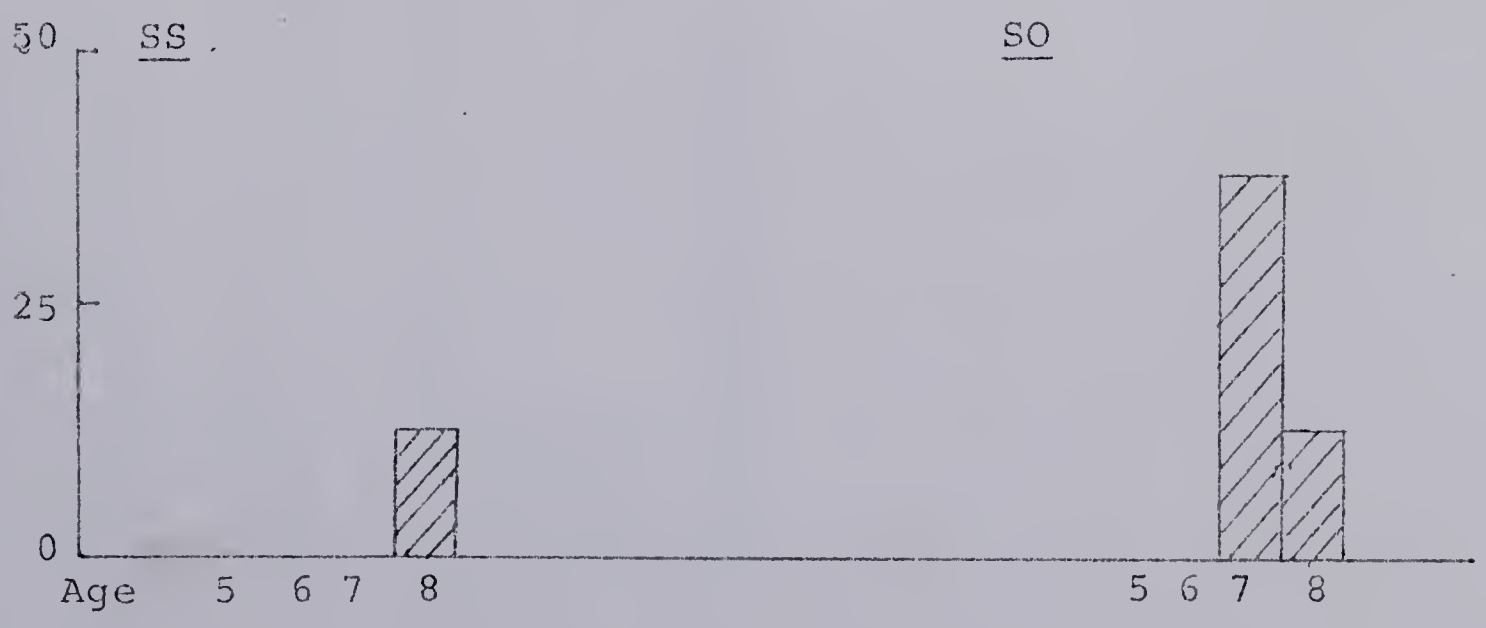
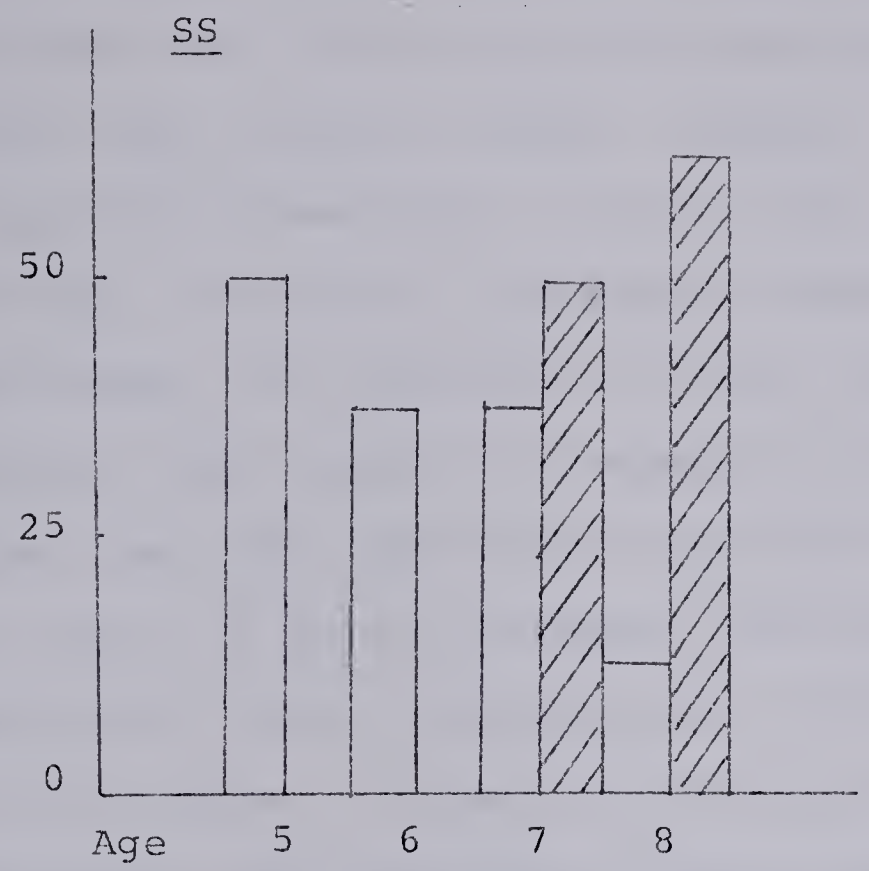
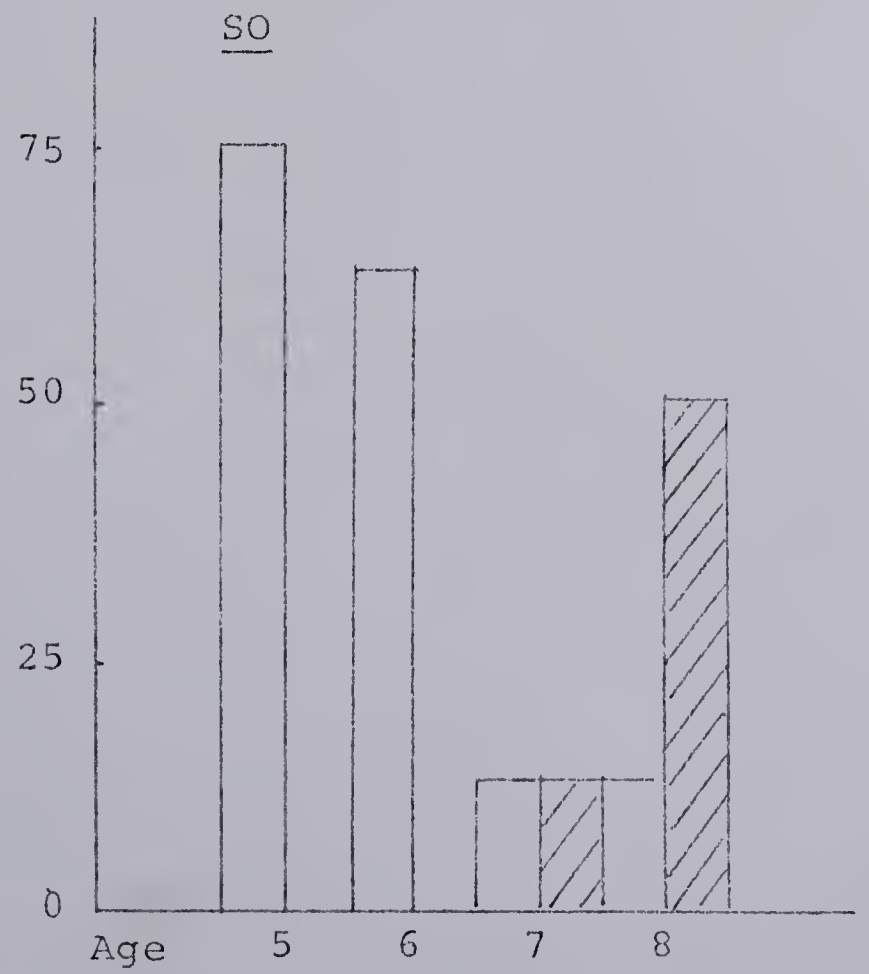


Figure 4.8

Frequency of Errors
(Imitation)
Conjoined Analysis and
Relative Clauses (Shadowed)
and Others (Blank)





were very few correct imitated responses across the four age groups, relatively little difference in production seems to exist among the children. Likewise, comprehension results indicate that rate of correct responses is fairly similar across age groups except youngest one, suggesting that linguisitic competence is not much different among the children. The only plausible explanation, then, may be attributed to differential short-term memory capacity because such capacity presumably increases with age. It is noted that rote repetition is possible if a given sentence is short or not too complex. Relative clauses are complex, but may not be too long for older children to be repeated in a rote manner. It may be the case that small children lag behind the older children in short-term memory storage.

5. SUMMARY AND CONCLUSION

5.1 The Results of the Experiment

The present experiment was conducted to test two hypotheses: (1) the hypothesis of ease of processing left-branching relative clauses (SS,SO types) over center-embedded structures (OS,OO types) and (2) the hypothesis of ease of processing subject focus (SS,OS types) over object focus (SO,OO types). The data supported the first hypothesis, but failed to support the second.

Both hypotheses are derived from the developmental principle of structural integrity. The principle predicts that if the main clause were interrupted by other linguistic units such as embedded clauses, it would be relatively more difficult to process. Hence, left-branching relative clauses should be easier than center-embedded structures. The principle also predicts processing difficulty of the relative clause in which the word order is rearranged. In Japanese the relativized NP is not permuted as is done in English, but is deleted from the relative clause. Accordingly, the principle may not predict the relative ease of processing subject focused relative clauses. However, the internal structure of relative clauses resulting from the deletion of the relativized noun phrase is relevant. While

the structure of the relative clause in subject focus conforms to the normal order O V where the object precedes the transitive verb, the structure in object focus corresponds to S V in which the subject directly precedes the transitive verb, thus leaving a syntactic gap between the subject and the verb in the relative clause. Since the relative clause in subject focus does not contain a gap, the principle of structural integrity applied to different foci predicts that subject focus is easier than object focus in Japanese relative clauses. The data, however, did not support the prediction. As discussed in the preceding chapter, the results may be attributed to the stage of linguistic development of the children or processing peculiar to the bilingual children in the present experiment.

5.2 Suggestions for Further Research

In the preceding chapter the developmental principles were evaluated in terms of the experimental results. The important findings are the confirmation of the operation of three developmental principles of cognitive precedence, functional exploitation and structural integrity in processing conjoined sentences and relative clauses of Japanese speaking children. In particular, the principle of structural integrity is potent in the prediction of ease of processing of left-branching structures over center-embedded clauses. Hence, the question naturally follows as to whether

the principle affects the processing of relative clauses of the child only or whether it also predicts the manner in which the adults process such constructions. Lynkowsky's (1980) extensive study of relative clauses indicates that adults and children tend to show similar response patterns in processing relative clauses. Her data with Ukrainian-speaking bilingual children demonstrated identical results observed in naturalness judgements of English and Ukrainian adults, showing that relative clauses in which the normal word order is preserved is easier. In contrast, English children favored right-branching relative clauses; an indication that the hardest constructions were center-embedded SS, SO types. Lynkowsky states that English children's results parallel the findings of the normative data reported by Prideaux et al. (1979). Aside from the issue of different factors affecting processing of relative clauses of English and Ukrainian children, it should be clear that adults and children alike appear to have the same processing difficulty in respect to a given sentence structure. Returning to Japanese relative clauses, will Japanese adults find center-embedded (OS,OO) structures hard to process just as children do? Or will the adults' facility of processing relative clauses be determined by other variables such as the word order in the relative clause?

Clarification of these questions depend on the results from adults' normative data. As mentioned in Chapter Two, the complexity judgement study of four types of relative

clauses is reported by Sheldon (1977). She found that center-embedded OS,OO types were not judged complex with the results of OS>OO,SS>SO in increasing order of complexity, contrary to developmental data. It was already noted that such differences may be attributed to a different particle employed after the subject of the main clause in Sheldon's study. In her test sentences the thematic particle *wa* was used, while the nominative particle *ga* was used in Harada et al.'s and present study. The function of thematic *wa* (Speaking of..., Talking of...) is to define the theme of a sentence. A given constituent, the theme, is fronted in the sentence and the accusative *o* is obligatorily deleted before *wa*. In the previous chapter the word order of four Japanese relative clauses was illustrated. The following sentences are a corresponding set of relative clauses with the thematic particle *wa*.

(1) SS: NP+*o* V NP+*wa* NP+*o* V

SO: NP+*ga* V NP+*wa* NP+*o* V

OS: NP+*wa* NP+*o* V NP+*o* V

OO: NP+*wa* NP+*ga* V NP+*o* V

While the conversion of *ga* into *wa* may not affect processing of left-branching relative clauses, it may facilitate the processing of center-embedded structures. Since the theme is something to be talked about or explained by the entire sentence, the adult can store it temporarily and start parsing a sentence from the second constituent in OS and OO types. Secondly, thematization does not apply to the

constituents in prenominal clauses such as relative clauses (Shibatani, 1979). As the theme coincides with the subject in most of the cases, the adult could assume the first NP *wa* as the subject of the main clause. On the contrary, in center-embedded constructions without the thematic *wa*, the adult may not notice the form of the relative clause until he reaches the third NP. As it is likely that he formulates the hypothesis of the first clause by that time, he has to discard it and start all over again. OO types, with two occurrences of *ga*, overtly signal the form of embedded structures, yet the deviant particle pattern possibly confuses him. On processing constructions with the thematic *wa*, adults need not move back to the initial constituent of a sentence. Accordingly, they might have judged these as easy in Sheldon's experiment.

In the study reported by Prideaux (1980), a set of relative clauses with the particle *ga* was employed to evaluate the four constructions in terms of naturalness. Prideaux found that Japanese native speakers judged subject focus significantly more natural than object focus with the results of SS>OS>OO,SO. The results that the SS type was judged most natural in Prideaux's experiment contrast with those in Sheldon (1977) and may be due to the function of the particle *ga*. This speculation must be clarified by experimental studies in the future. Such studies, however, have to be carried out in the general perspective of the effect of the function of the theme on sentence processing.

In addition to these sets of relative clauses, we have another set in which a subject of an embedded clause is marked as *no*. In Japanese a subject marker *ga* is optionally converted into *no* in embedded clauses such as relative clauses and noun phrase complements (Shibatani, 1975). The corresponding set with the subject marker *no* are given below.

(2)

SS:	NP+*o*	V	NP+*ga*	NP+*o*	V
SO:	NP+*no*	V	NP+*wa*	NP+*o*	V
OS:	NP+*ga*	NP+*o*	V	NP+*o*	V
OO:	NP+*ga*	NP+*no*	V	NP+*o*	V

Compared to (1), the difference is shown in the particles after the first NP in SO types and after the second NP in OO types. The question of whether *ga-no* conversion affects the processing of the relative clauses as thematization still remains to be answered.[7]

Up to this point, it was assumed that adults fully master the functions of particles and utilize them as cues in sentence parsing. In contrast to the adults, children appear to pay attention only to the word order. Accordingly, the adoption of particular particles may not make much

---

[7]Uyeno & Harada (1975) investigated processing differences of underlying forms and transformationally derived forms of various sentence types, including *ga-no* conversion. It was found that there was no significant difference between two constructions. The conversion was tested on OO types with the thematic *wa*. Therefore, the function of particles are confounded so that no definite conclusion can be drawn from the data.

difference in processing complex sentences such as relative clauses.[8] It is interesting to note that the factor separating the easier type from the more complex pair is found to be word order in both Prideaux's (1980) and Sheldon's (1977) studies with adults as subjects. Considering that interruption is the major factor in children's processing relative clauses, adults and children seem to employ different processing strategies.

5.3 Conclusion

The main findings of the present experiment are summarized as follows: performance generally improves with age, comprehension was better than imitation, conjoined sentences were easier than relative clauses. Among the relative clause structures, left-branching relative clauses were processed better than center-embedded structures, thus supporting the first hypothesis, that of non-interruption. The second hypothesis, which states that subject focused relative clauses are easier to process than object focused structures, however, is not supported by the data.

The present study indicates that the position of the relative clause is the most important factor to affect the child's processing of relative clause structures. It was Sheldon (1972, 1974, 1976, 1977) who attempted to

---

[8] Hayashibe (1975) reported that the child begins to utilize particles as cues in processing simple sentences around the age of five or six.

investigate sentence processing strategies systematically, employing relative clause structures. In her developmental studies, she tested the Interruption Hypothesis and Word Order Hypothesis which are subsumed under the principle of structural integrity in the present study. Sheldon's data did not support either of the two hypotheses. In order to explain her data Sheldon proposed the Parallel Function Hypothesis, which claims that a relative clause is easier to process if the relativized NP plays the same grammatical function as the NP (i.e. its head) modified by the relative clause. Since then much research has been carried out to test her claim, although without much success (e.g., M. Smith, 1974; Harada et al., 1976; Lynkowsky, 1980). The present study did not support the Parallel Function Hypothesis, either. Instead, it has shown that the position of the relative clause is the most important factor in predicting the facility of processing relative clauses for Japanese speaking children. Slobin (1973) suggested that constraints on sentence processing by interruption is a universal principle of acquisition. The results of the present study provide further evidence for his claim.

REFERENCES

Bever, T. G. The cognitive basis for linguistic structures. In J. R. Hayes (ed.), *Cognition and the development of language*. New York: Wiley & Sons, 1970, 279-352.

Bellugi, U. Simplification in children's language. In R. Huxley & E. Ingram (ed.), *Language acquisition: Models and methods*. New York: Academic Press, 1971, 95-117.

Braine, M. The acquisition of language in infant and child. In C. Reed (ed.), *The learning of language*. New York: Appleton, 1971, 7-95.

Brown, H. D. Children's comprehension of relativized English sentences. *Child Development*, 1971, *42*, 1923-1936.

Chomsky, N. *Aspects of the theory of syntax*. Cambridge, Mass.: M.I.T. Press, 1965.

Chomsky, N. & G. A. Miller. Introduction to the formal analysis of natural languages. In R. D. Luce, R. R. Bush, and E. Galanter (eds.), *Handbook of mathematical psychology*, *2*, New York: Wiley and Sons, 1963.

Clark, H. H. & E. V. Clark. *Psychology of language*. New York: Harcourt Brace Javanovich, Inc., 1977.

Cook, V. J. Strategies in the comprehension of relative clauses. *Language and Speech*, 1975, *18*, 204-212.

Downing, E. T. Some universals of relative clause structures. In J. H. Greenberg (ed.), *Universals of human language*. Stanford, California: Stanford University Press, 1978, 375-418.

Fodor, J. A. & M. F. Garrett. Some syntactic determinants of sentential complexity. *Perception and Psychophysics*, 1967, *2*, 289-296.

Foss, D. J. & R. H. Lynch. Decision processes during

sentence comprehension: Effects of surface structure on decision times. *Perception and Psychophysics*, 1969, *5*, 145-148.

Fraser, C., Bellugi, U. & R. Brown. Control of grammar in imitation, comprehension, and production. *Journal of Verbal Learning and Verbal Behavior*, 1963, *2*, 121-135.

Gaer, E. Children's understanding and production of sentences. *Journal of Verbal Leargning and Verbal Behavior*, 1969, *8*, 289-294.

Hakes, D. T. & H. S. Cairns. Sentence comprehension and relative pronouns. *Perception and Psychophysics*, 1970, *8*, 5-8.

Harada, K. I. Acquisition of Japanese relative clauses: A case study on a two year old. *Annual Reports*, Division of Language, International Christian University, *1*, 1-16.

Harada, S. I., T. Uyeno, H. Hayashibe, & H. Yamada. On the development of perceptual strategies in children: A case study on the Japanese child's comprehension of the relative clause constructions. *Annual Bulletin RILP*, 1976, *10*, 199-224.

Hayashibe, H. Word order and particles: A developmental study in Japanese. *Descriptive and Applied Linguistics*, International Chiristian University, *8*, 1-18.

Kuno, S. *The structure of the Japanese language*. Cambridge, Mass.: M.I.T. Press, 1973.

Limber, J. The genesis of complex sentences. In T. E. Moore (ed.), *Cognitive development and the acquistion of language*. New York: Academic Press, 1973, 169-185.

Lynkowsky, P. *The development of relative clauses: Comprehension strategies in English and Ukrainian*, Unpublished doctoral dissertation, University of Alberta, 1980.

Mcneill, E. The development of language. In P. Mussen (ed.),

Carmichael's manual of child psychology. (Vol. 1), New York: Wiley, 1970, 1061-1163.

Maratsos, M. P. & S. A. Kuczaj. Evidence from elicited imitation for productive competence in a grammatical system. *Papers and Reports on Child Language Development*, 1974, *8*, 65-77.

Miller, G. A. & S. Isard. Free recall of self-embedded English sentences. *Information and Control*, 1964, *7*, 292-303.

Neisser, U. *Cognitive psychology*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1967.

Noizet, G., F. Deyts & J. P. Deyts. Producing complex sentences by applying relative transformation. *Linguistics*, 1972, *89*, 49-68.

Piaget, J. *Six psychological studies*. New York: Vintage Books, 1967.

Piaget, J. Piaget's theory. In P. H. Mussen (ed.), *Carmichael's manual of child psychology*. (Vol. 1), New York: Wiley, 1970, 175-196.

Prideaux, G. D. The acquisition of relative clauses: A functional analysis. *Canadian Journal of Linguistics*, 1979, *24*, 25-40.

Prideaux, G. D. The role of perceptual strategies in the processing of English relative clause structures. Paper to be presented at the Eighth International Conference on Computational Linquistics, Tokyo, Japan, October, 1980.

Prideaux, G. D., P. E. Lynkowsky & J. T. Hogan. Processing of relative clauses: The demise of the parallel function hypothesis. Paper presented at the Annual Meeting of Western Conference on Linguistics, Burnaby, B.C., October, 1979.

Rosenbaum, P. *Grammar of English predicate constructions*. Cambridge, Mass.: M.I.T. Press, 1967.

Sano, K. An experimental study on the acquisition of Japanese simple sentences and cleft sentences. *Descriptive and Applied Linguistics*, International Christian University, 1977, *10*, 213-233.

Sheldon, A. *The acquisition of relative clause in English*. University of Texas at Austin doctoral dissertation, Bloomington: Indiana University Linguistic Club, 1972.

Sheldon, A. The role of parallel function in the acquisition of relative clauses in Englsh. *Journal of Verbal Learning and Verbal Behavior*, 1974, *13*, 272-281.

Sheldon, A. Speaker's intuitions about the complexity of relative clauses in Japanese and English. *Papers from the 12th Regional Meeting of the Chicago Linguistic Society*, 1976, *12*, 558-567.

Sheldon, A. On strategies for processing relative clauses: A comparison of childern and adults. *Journal of Psycholinguistic Research*, 1977, *4*, 305-318.

Shibatani, M. Perceptual strategies and the phenomena of particle conversion in Japanese. *Papers from the parasession on functionalism*, the Chicago Linguistic Society, 1975, 469-480.

Shibatani, M. *Nihongo no bunseki*, Tokyo: Taishukan, 1978.

Sinclair, H. & J. P. Bronckart. SVO A linguistic Universal? A study in developmental psycholinguistics. *Journal of Experimental Child Psychology*, 1972, *14*, 329-348.

Slobin, D. I. Developmental psycholinguistics. In W.O. Dingwall (ed.), *A survey of linguistic science*. Linguistics Program, University of Maryland, 1971, 298-410.

Slobin, D. Cognitive prerequisites for the development of grammar. In C. A. Ferguson & D. I. Slobin (eds.), *Studies of child language development* New Yord: Holt, Rinehart and Winston, 1973, 175-208.

Slobin, D. I. & C. Welsh. Elicited imitation as a research

tool in developmental psycholinguistics. In C. A. Ferguson and D. I. Slobin (eds.), *Studies in child language development*. New York: Holt, Rinehart & Winston, 1973, 485-497.

Smith, C. S. An experimental approach to childern's linguistic competence. In J. R. Hayes (ed.), *Cognition and the development of language*. New York: Wiley & Sons, 1970, 109-133.

Smith, M. Relaive clause formation between 29-36 months: A preliminary report. Stanford University, Committee on Linguistics. *Papaers and Reports in Child Language Development*, 1974,*8*, 104-110.

Stolz, W. S. A study of the ability to decode grammatically novel sentences. *Journal of Verbal Learning and Verbal Behavior*, 1967, *6*, 867-873.

Uyeno, T. and S. I. Harada. Perception of syntactic structures in Japanese, *Annual Bulletin RILP*, 1975, *9*, 171-192.

Uyeno, T., S. I. Harada, H. Hayashibe, & H. Yamada. Comprehension of simple sentences and relative clause constructions in childern with hearing disorders. *Annual Bulletin RILP*, 1977, *11*, 113-130.

Winer, B. J. *Statistical principles in experimental design*. (2nd ed.) New York: McGraw Hill, 1971.

APPENDIX A

Test Sentences Used in the Comprehension and Imitation Tasks

Relative clause structures

Subject/Subject (SS):

1.犬を飛びこえた象が猿をなでた.

2.猿を押した兎が馬を飛びこえた.

Subject/Object (SO):

1.犬が飛びこえた象が猿をなでた.

2.馬が押した兎が犬を飛びこえた.

Object/Subject (OS):

1.犬が象を飛びこえた兎をなでた.

2.馬が猿をなでた象を押した.

Object/Object(OO):

1.犬が象が飛びこえた兎をなでた.

2.兎が猿がなでた馬を押した.

Conjoined sentences

S *conj.* S O V:

1.象と猿が犬を飛びこえた.

2.兎と馬が猿を押した.

S O *conj.* O V:

1.象が犬と兎を飛びこえた.

2.馬が猿と象を押した.

S O V *conj.* O V:

1.象が馬を飛びこえて兎を押した.

2.兎が猿をなでて犬を飛びこえた.

S O V *conj.* S O V:

1. 馬が兎を飛びこえて、馬が象を押した.
2. 犬が象をなでて 犬が猿を飛びこえた.

Romanization of the Test Sentences

Relative clause structures

Subject/Subject (SS):

1. inu o tobikoeta zoo ga saru o nadeta
2. saru o osita usagi ga uma o tobikoeta

Subject/Object (SO):

1. inu ga tobikoeta zoo ga saru o nadeta
2. uma ga osita usagi ga inu o tobikoeta

Object/Subject (OS):

1. inu ga zoo o tobikoeta usagi o nadeta
2. uma ga saru o nadeta zoo o osita

Object/Object(OO):

1. inu ga zoo ga tobikoeta usagi o nadeta
2. usagi ga saru ga nadeta uma o osita

Conjoined sentences

S *conj.* S O V:

1. zoo to saru ga inu o tobikoeta
2. usagi to uma ga saru o osita

S O *conj.* O V:

1. zoo ga inu to usagi o tobikoeta
2. uma ga saru to zoo o osita

S O V *conj.* O V:

1. zoo ga uma o tobikoete usagi o osita
2. usagi ga saru o nadete inu o tobikoeta

S O V *conj.* S O V:

1. uma ga usagi o tobikoete uma ga zoo o osita
2. inu ga zoo o nadete inu ga saru o tobikoeta